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Presentation of the five Monographs on Swallows and Swifts by Lazzaro Spallanzani

Abstract

Lazzaro Spallanzani (1729-1799) was a well-known Italian biologist and natural history researcher, author of numerous letters, articles and booklets, translated into French, German and English which allowed him to gain access to the most important scientific societies of his time, both in Italy and abroad. He was a careful observer and proficient at laboratory experiments. In particular, he took keen interest in Barn Swallows, House Martins, Sand Martins, Common Swifts and Alpine Swifts, to which he dedicated five thoroughly detailed monographs in tome six of his famous work "Viaggi alle Due Sicilie e in alcune parti dell'Appennino". Thanks to which, he was able to achieve fame and success in Italy and Europe. These monographs contain many predictions to future scientific discoveries, but should nonetheless be judged according to the scientific culture of the 18th century, especially in the paragraphs concerning remarks on animal experiments that today would be viewed as unacceptable. After 227 years, the five monographs and their preliminary notes have been translated into English to make the texts available for international readers and offer an insight into the intuitive and meticulous mind of a prolific and eclectic scientist of the past, who under many aspects is still regarded as innovative and modern.

Riassunto

Presentazione dei cinque Opuscoli su Rondini e Rondoni di Lazzaro Spallanzani. *Lazzaro Spallanzani (1729-1799) fu un ricercatore eclettico e prolifico, autore di numerosi testi, lettere e opuscoli, tradotti anche in francese, tedesco e inglese, che lo introdussero nelle maggiori società scientifiche del suo tempo, in Italia e all'estero. Fu un attento osservatore e rigoroso sperimentatore in laboratorio. Si interessò di rondini, balestrucci, topini, rondoni comuni e rondoni maggiori, dedicando loro cinque ampi opuscoli nel tomo sesto dei suo celebri "Viaggi alle Due Sicilie e in alcune parti dell'Appennino", un'opera che consolidò la sua fama in Italia e oltralpe. Naturalmente i cinque libretti, ricchi di anticipazioni, devono essere valutati con riferimento alla cultura scientifica del secolo XVIII, soprattutto nelle parti relative ad aspetti di sperimentazione animale oggi inaccettabili. I cinque opuscoli e la loro presentazione sono introdotti e tradotti per essere accessibili,*

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dopo 227 anni, anche per il lettore anglofono e permettergli di accedere ai testi e allo spirito intuitivo e meticoloso di un grande scienziato del passato, per molti aspetti ancora attuale.

Keywords: *Lazzaro Spallanzani, Common Swift, Alpine Swift, Barn Swallow, House Martin, Sand Martin*

Parole chiave: *Lazzaro Spallanzani, Rondone comune, Rondone maggiore, Rondine comune, Balestruccio, Topino*

1. Foreword

In 1797, after publishing the five tomes of his *Viaggi alle Due Sicilie e in alcune parti dell'Appennino* [lit. *Journey to the Two Sicilies (southern Italy) and parts of the Apennines*] (1792-1795), Lazzaro Spallanzani printed tome six as an appendix featuring eight monographs, concerning species he occasionally encountered in his travels. The first five monographs are about the *Rondini* (Italian for Swallows), term which he uses referring to swallows, martins and swifts, whereas the sixth monograph focuses on the Scops Owl (*Otus scops*) and the seventh and eighth about the European Eel (*Anguilla anguilla*). This appendix had been planned since the beginning, as the Author himself declares in the preface to Tome I, where he specifies that in this work, he will add his observations on the *rustica*, *urbicum*, *riparia*, *apus* and *melba* species carried out on the Aeolian Islands, thus adding them to many other observations collected during his previous studies. Spallanzani refers to these five species as *Swallows*, in deference to the systematics of his time, which put together swallows, martins and swifts. In the print order, the five monographs are dedicated to the Barn Swallow, House Martin, Common Swift, Sand Martin and Alpine Swift, respectively; therefore, to three species of swallows and two species of swifts (cf. Prinzinger & Siedle, 1988; Turner & Rose, 1989; Brichetti & Fracasso, 2007a-e; Gill & Donsker, 2019).

The abundance of information collected, the tests and data contained in these monographs greatly enhanced knowledge on these species, anticipating and predicting future discoveries in many aspects. Therefore, these booklets are still valid, although within the limits of the scientific knowledge of that time, and confirm their Author as a pioneer even in ornithology. Spallanzani systematically identified the birds one by one to demonstrate the fidelity of the adults to their nest as soon as they arrived in the spring and during breeding season. As a researcher, he also proved to be ruthless and meticulous in disproving wrong consolidated beliefs, which nevertheless remained popular for many years even after his demise, such as the belief that in winter swifts hibernated in old buildings and swallows at the bottom of ponds and lakes like fish.

An example of innovation in these booklets are the 18th century technical

vocabulary and idioms which resulted in a lack of understanding by Italian readers. Therefore, after a first translation into contemporary Italian (Ferri, 2022), we decided to make them available in English for a wider international audience of researchers and aficionados, who so far could rely only on old French translations (Paris, 1799-1800; Hamburg, 1799). Moreover, we decided to introduce these booklets by taking into account Spallanzani's knowledge both in science and in humanities including his eclectic method in a thoroughly detailed scientific production. In conclusion, we will discuss the unique structure of his five monographs, which are linked to one another together with several remarks.

2. Education, activities and works of Lazzaro Spallanzani

Lazzaro Spallanzani – rather *Lazaro Nicola Francesco Spallanzani* – was born on 12th January 1729 in Scandiano (province of Reggio Emilia, Italy), into a large family, son of a jurist. At the age of 15, he entered the College of the Jesuits in Reggio Emilia and in 1749 he enrolled at the University of Bologna to study law. Nevertheless, he soon decided to focus on studying philosophy together with ancient Greek, French, maths and natural history. He was highly motivated and supported by the university professor of experimental physics Silvia Bassi (1711-1778), who was a distant cousin of his. She was the first woman to have a doctorate in science, and the second woman in the world to earn the Doctor of Philosophy degree. Afterwards, he went back to Reggio Emilia to teach Greek at the Seminar and maths at the local university, during which he was ordained priest in 1762, and since then he was commonly referred to as "Abbot"; a title that he himself used when signing his publications. In the same year, he moved to Modena to teach maths and Greek at Collegio San Carlo and philosophy at the university. Since 1760, he had been dedicating most of his studies to natural history, both in the field and in the laboratory, publishing, among other works, an essay entitled *Saggio di osservazioni microscopiche concernenti il sistema della generazione de' signori di Needham e Buffon* (1765). This article proved his proficient scientific skills considering that at first he was supposed to acknowledge the principle of spontaneous generation supported by these two famous Authors, although he soon dismissed this theory thanks to his Galilean research approach. In addition, by commenting the experiments of the surgeon and naturalist Francesco Redi (1626-1697) on spontaneous generation, he demonstrated that the theory was without solid foundation after his own experiments with infusions, which did not decay after having been boiled and sealed with fire inside glass tubes. This discovery made him famous all over Europe and paved the way for the studies of Louis Pasteur (1822-1895) a century later.

In 1769, he was appointed chair professor of natural sciences at the University of Pavia (Lombardy), where he was able to fully express his

vocation as a scientist and professor by linking his teaching method to the work *Contemplation de la nature* by the Swiss naturalist Charles Bonnet (1764-65), which he translated into Italian for both his students and the general public. His intense teaching did not divert him from a long series of journeys all over Italy and abroad, which served as field research, during which he collected plenty of material and specimens for conducting his laboratory experiments, for his personal cabinet of curiosities and, most importantly, for the Natural History Museum of Pavia University. Spallanzani himself (Fig. 1) established this important cultural institution in 1771 and was its director until his death, thus making it a milestone of the international scientific community of his time.

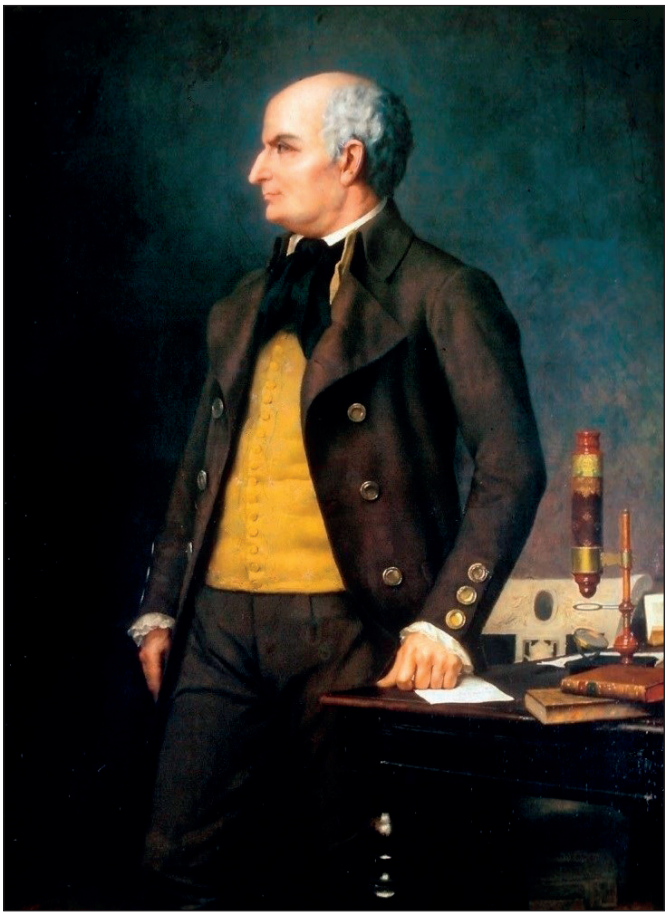


Fig. 1 – *Lazzaro Spallanzani in a portrait by Albert-Jules Édouard (late 19th century, Pasteur Museum collection, Paris).*

Furthermore, Spallanzani published studies on reproduction, artificial fertilisation, marine biology, geology, meteorology, chemistry, physics, vegetal physiology, tardigrades and infusers, as well as corresponding with many Italian and European scholars. His publications increased and consolidated his fame and soon he became a member of the main scientific associations in Italy and Europe. Among which "The Academia dei Dissonanti of Modena", "The Institute of Sciences of Bologna", "the Royal Academy of Sciences and Literature of Mantua", "The Royal Society of London" (1768), "The Royal Swedish Academy of Sciences" (1775) and many others.

Indeed, Spallanzani was a well-known scientist also outside Italy, as reported by the famous French surgeon Dominique-Jean Larrey when, at the end of Napoleon's Italian campaign of 1797, he went to Pavia to pay a tribute to – as Larrey would say – *à l'immortel Spalanzani* (Larrey, 1812).

In 1796, with the approach of Napoleon's first Italian campaign, the Austrian government had closed the University of Pavia and Spallanzani spent most of his time in in his hometown of Scandiano. He was later offered a chair at the University of Paris which he declined, preferring to return to Pavia, where he remained till his death on 11 February 1799.

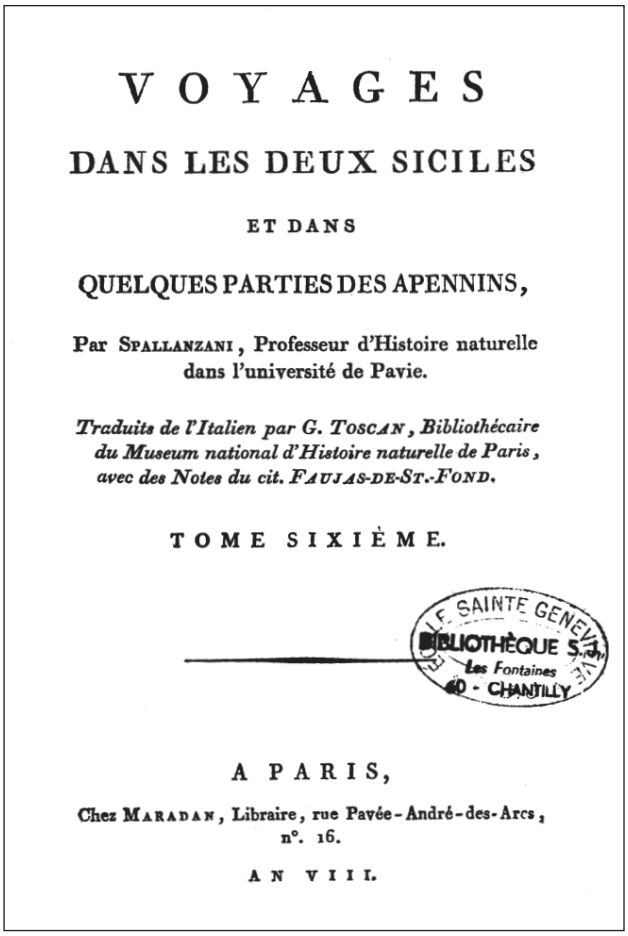
After his death, his private collection of "*natural productions*", which was kept in his house in Scandiano, was handed over to the Municipality of Reggio Emilia and was later displayed in the Civic Museums of this town, where it is still visitable, preserved in its original state.

3. The translation of his *Viaggi* and *Opuscoli*

The *Viaggi alle Due Sicilie e in alcune parti dell'Appennino* was Spallanzani's most successful work. It was published in six tomes (1792, 1793, 1795 and 1797), out of which the most interesting for us is the sixth and last tome, written as an appendix to his *Viaggi*. This chapter contains eight *Opuscoli sopra Diversi Animali* [*Monographs on Various Animals*], in which he describes his observations collected during his journeys and those resulting from his previous research career.

Thanks to Spallanzani's notoriety as a member of several Italian scientific societies, this new work immediately rose to popularity, and was reprinted shortly after in Venice in 1794 and 1796-1797. But since he was well-known also in Europe thanks to his correspondence with many foreign colleagues, there were also translations into German in 1795-1798 (Leipzig) and into English in 1798 (London), although they did not include Tome VI of his Monographs, which had been printed only in 1797. In 1794, the first French translation (Paris) was published, limited only to Tome I, which was later followed by three translations: in Bern (1795-1797) limited to the first five

Tomes, in Paris (1799-1800) with a full edition (Fig. 2) and in Hamburg (1799) similar to the Paris version. A thorough research of digital copies on the Internet allowed the comparison of the results with two specialised catalogues (Prandi, 1952; Troelstra, 2017). This was achieved thanks also to the contribution of Ulrich Tigges (personal communication), a researcher with a keen interest in topics related to swifts, who found the first issue online of *Esprit des Journaux* by Jean-Jacques Tutot (1796). From this paper, it was clear that Tome I of the *Voyages* had already been translated into French at the *Imprimerie des Sciences et des Arts* of Paris in 1796 with the complete *Introduction*.



VOYAGES

DANS LES DEUX SICILES

ET DANS

QUELQUES PARTIES DES APENNINS,

Par SPALLANZANI, Professeur d'Histoire naturelle dans l'université de Pavie.

Traduits de l'Italien par G. TOSCAN, Bibliothécaire du Museum national d'Histoire naturelle de Paris, avec des Notes du cit. FAUJAS-DE-ST.-FOND.

TOME SIXIÈME.

SAINTE GENEVIÈVE
BIBLIOTHÈQUE S.J.
Les Fontaines
60 - CHANTILLY

A PARIS,

Chez MARADAN, Libraire, rue Pavée-André-des-Arcs, n°. 16.

AN VIII.

Fig. 2 – *Inner frontispiece of the Paris edition of Tome VI of the* Voyages*, printed in the year VIII of the French revolutionary calendar (1799-1800).*

This fact is relevant because, for the first time, it was announced in France that essays on the species *rustica*, *urbicum*, *riparia*, *apus* and *melba* would complete this work. Thanks to a digital copy, found again by U. Tigges, we can confirm that a second German translation with the title *Gemählde aus dem Naturreiche beyder Sicilien* was published in Austria in 1824. However, this edition included only the *Viaggi alle Due Sicilie,* without Tome V on the Apennines and Tome VI with the monographs on birds. Therefore, although the first five tomes of the *Voyages* translated into French, German and English had become widespread across Europe, Tome VI containing the monographs here discussed was available outside Italy only in French with the two editions of Paris and Hamburg.

4. Influence of Spallanzani's Monographs on other Authors

We will not comment any further reprints of the six tomes of his *Viaggi* published in Italy, which are listed and described in detail in a specific edition (Vaccari, 2007). Rather, we prefer to concentrate on the impact of Spallanzani's studies on the biology and behaviour of swallows and swifts with many scientific anticipations, both in Italy and abroad. Nevertheless, we cannot say for sure that the Italian and French ornithological institutions of the 19th and 20th century gained any significant knowledge thanks to Spallanzani's studies, filled with predictions, intuitions and new data, apart from very short quotations (Levrault, 1823; Colin, 1873). The lack of texts translated into German, though, did not prevent occasional references (Quantz, 1925), as confirmed by the thorough analysis of the Common Swift (*Apus apus*) by Weitnauer & Scherner (1980) on their "Guide to the Birds of Central Europe". This book contains ten of Spallanzani's interesting quotations (one also about the Alpine Swift), in which he seems to stand out among the other authors mentioned, who are all modern or from the present day. In the same year, Weitnauer also printed his famous work *Mein Vogel, aus dem Leben des Mauersegler Apus apus*, by updating his previous articles, in particular *Am Neste des Mauersegler* (1947), in which Spallanzani is mentioned once in the text, however Weitnauer did not quote him in his references (Weitnauer, 1980, p. 78).

Nothing is found on Spallanzani in British publications, such as the thorough essay on the common swift written by Finnish naturalist J. Koskimies (1950). The same could be said about the famous *Swifts in a tower* by David Lack (1956) if it was not for a singular detail: this Author quotes Spallanzani only once in a short sentence reporting his tests of swallows' endurance to cold in order to debunk the theory of their hibernation underwater. Furthermore, he is quoted also in the index of famous people and places, although Lack does not mention a single work by Spallanzani. Lack's source could only be *Tracts on*

the natural history of animals and vegetables, a translation of his *Opuscoli di fisica animale e vegetabile* (1776), an essay rich in details about the freezing experiments performed by Spallanzani both on swallows and swifts, although the latter are not mentioned in Lack's book on the Common Swift.

Moreover, *Tracts on the natural history of animals and vegetables* was well-known to Henry Reeve, who quotes it in one of his essays (Reeve, 1809), although he refers to Spallanzani's experiments on other animals rather than on swallows and swifts. This Author dedicates a large amount of work to the persisting belief (not only among non-academics and uneducated people) that swallows and swifts hibernate underwater. By quoting Spallanzani's observations on swallows on the isle of Lipari, he declares: «*I do not find that he has anywhere fulfilled his promise of publishing the observations he made on the swallows of Lipari and Sicily; but, as he excluded these birds from his experimental researches on hibernation, I take his silence as conclusive evidence against the truth of the vulgar opinion concerning them*». This makes us doubt that he had in fact read *Tracts on natural history*, where, on the contrary, the amount of space dedicated to these tests is much larger.

More surprising is the statement by the famous English naturalist Gilbert White, in a paragraph of his *Natural History of Selborne*, in which he writes: «*Spallanzani says very decidedly, that swallows retire under water at the time of their disappearance from this country; but acknowledges that he had never himself observed it, though his belief of the fact seemed certain. He had performed a variety of experiments to resolve the question, if cold would have the effect of producing torpidity, and confined swallows in different ways under snow and ice, and in an ice-house. The result, however, was always death, when the temperature and period of immersion were prolonged beyond a certain period; and the conclusion he draws is, that at least our species of hirundinidæ did not become torpid*» (White, 1789, p. 297).

As for this quotation referring to Spallanzani, obviously due to indirect knowledge of *Opuscoli di fisica animale e vegetabile*, considering it had been translated into English several times, so much so that White (1789) evidently ignored the fact that these experiments were carried out also on swifts, which were a species of great interest for him. In particular, White's idea that Spallanzani believed in the underwater hibernation of swallows is quite bizarre, since this statement is not found in any of his writings. In fact, with his freezing experiments Spallanzani actually debunked this widespread belief that had been around for centuries (Olaus Magnus, 1565). Perhaps, White's negative perspective might be influenced by the opinion of other Authors, such as Giovanni Antonio Scopoli (1723-1788), a colleague of Spallanzani at Pavia University, who was well-known to White. Scopoli always looked down on and used to belittle Spallanzani, to the point of organising a real

conspiracy against him. Scopoli anonymously accused Spallanzani of stealing a large number of specimens from the university museum in order to place them in his private collection at home in Scandiano. This accusation, though, was dismissed after a government legal investigation that resulted in Scopoli and the other conspirators losing the case (Mazzarello, 2021).

Furthermore, we see that the English physician and scientist Edward Jenner (1824) used to mark swifts in order to recognise the same individuals from one year to the next, similarly to what Spallanzani did in his experiments on swallows and swifts. Nevertheless, in his works Jenner never quoted the Italian author.

Even Scottish naturalist James Rennie (1835) followed Spallanzani's steps regarding mostly digestion and hibernation, but also reporting the Spallanzani's observations of swallows in October in the Mediterranean islands and their cold endurance tests, although he never quoted his source of information.

Going back to Lack (1956), it has emerged that his knowledge on Spallanzani's experiments on swallows was only superficial, and he was not aware that these tests were performed on swifts as well; therefore, he ignored Spallanzani's work *Tracts on the natural history of animals and vegetables* that dealt with this topic. Evidently, Lack also ignored the five monographs, either in Italian or French, otherwise he would have noticed that Spallanzani's had marked a pair of swifts with a crimson silk thread tied to their legs and had later recovered one of them the following year within the cavity in which it had bred. Moreover, Spallanzani continued marking swifts and other bird species with other methods. If Lack had known about Spallanzani's tests, he would not have dedicated so much space to the German painter and naturalist Johann Leonard Frisch (1666-1743), who marked some swallow specimens by tying coloured threads to their legs, with the purpose of checking whether the threads had changed colour when they returned to their nest the following spring. By noticing that the threads had retained their original colour, he deduced – using a somewhat strange logic – that the birds could not have spent the winter underwater otherwise the colour would have faded (!) (Frisch, 1736).

A thorough publication entitled *The bibliography of the Common Swift with content keys from the beginnings up to the present* was recently published by Baruch & Ferri (2023a). It contains over 8,400 references on swifts from all over the world, with more than 80 key topics in seven languages (both European and Asian). There are also several references to Spallanzani's works, such as *Opuscoli di fisica animale vegetabile*, the Tome IV of his *Voyages* and the Monographs of Tome VI in Italian, the Leipzig and Vienna German editions of his *Voyages*, the Monograph in French on the Common Swift and the *Tracts on natural history of animals and vegetables*. The latter are quoted in several paragraphs of the more comprehensive *Mauersegler, Das ABC des besonderen Himmelvogels* (Baruch & Ferri, 2023b).

Finally, during the "1st Common Swift Seminar", held in Berlin in April 2010, the keen and profound interest of Spallanzani for swifts was widely debated, together with elements of his correspondence with other experts on swifts (Ferri, 2010).

5. Origin, subject and purpose of Spallanzani's Monographs

As previously discussed, in 1797, soon after the success of his five tomes of the *Viaggi alle Due Sicilie e in qualche parte dell'Appennino*, Spallanzani published a sixth tome as an appendix to his work, significantly entitled *Opuscoli sopra Diversi Animali* [*Monographs on Various Animals*]. This appendix was already announced in the introduction at the beginning of Tome I (1792), where he declares that for several years he had been studying "*the natural habits of the* rustica*,* urbicum*,* riparia*,* apus *and* melba *swallow species*".

Thanks to his strong personality and qualities as a scientist, Lazzaro Spallanzani has been recently reappraised as the first modern naturalist and among the forerunners of genetics (Agnoli & Pennetta, 2012). Indeed, he was a passionate observer, meticulous in his notes, scrupulous in searching written sources and diligent in verifying his observations and intuitions by means of experiments. His monographs are a further testimony of his commitment as a scientist applying the Galilean method of investigation, based on acute observations, rigorous measurements and laboratory trials.

6. The Monographs on Swallows and Swifts

In examining the five monographs on swallows and swifts, we can see they deal with Barn Swallow, House Martin, Common Swift, Sand Martin and Alpine Swift, specifically in this order. This mixed treatment of species belonging to such different taxonomic families should not surprise us since in those days swifts were thought to belong to the same family of swallows. Indeed, only two centuries later were the swifts placed for the first time in a super-order together with the hummingbirds (*Trochilidae*, cf. Sibley & Ahlquist, 1991), and afterwards placed in a clade with owlet-nightjars (*Aegotheles*, cf. Sangster, 2005).

A further point is that three species of *Swallows* are missing in all Spallanzani's essays, despite one may expect them to be known even in those days. The Red-rumped Swallow (*Cecropis daurica* Laxmann, 1769), the Crag Martin (*Ptyonoprogne rupestris* Scopoli, 1769) and the Pallid Swift (*Apus pallidus* Shelley, 1870). Yet, their absence in Spallanzani's works is justifiable considering the lack of knowledge that the he had on these birds. The Red-rumped Swallow was identified in 1769 by the Swedish naturalist and explorer

Erik Gustav Laxmann, but its presence has always been sporadic in Italy. As for the Crag Martin, Spallanzani might have deliberately neglected this species in order to avoid acknowledgements to his colleague Giovanni Antonio Scopoli – who was the first to describe it – considering the very bad relationship between the two scholars (Baldaccini, 2007; Mazzarello, 2021). Finally, the Pallid Swift was recognised as a separate species only much later, in 1870, by the British geologist and ornithologist George Ernest Shelley. Considering that this bird is very similar to the Common Swift (Pellegrino *et al*., 2017), up to then it was very easy to confuse the two; Spallanzani himself might have observed it without even knowing. This is suggested by two passages from the third monograph concerning the swifts that he had observed during a holiday in Fanano, a village in the Modena Apennines (640 m a.s.l.), in an artificial nest derived from a hole in his bedroom wall, which could easily have been Pallid Swifts, seeing as this was after July the 26th, a time when Common Swifts have already left their breeding sites and the juveniles have already fledged. In addition, when he observed a flock of swifts on 7 November 1779 in Reggio Emilia, these too may also have been Pallid Swifts, considering that in late summer and autumn it is more likely to spot Pallid Swifts due to their delayed migrating habits. As for the former observation in Fanano, it should be reported that at only 3 km away, in the village of Sestola, at a much higher altitude (1,020 m a.s.l.), there is to date a small colony of Pallid Swifts, as referred by F. Ballanti & A. Ravagnani (who provided the information personally).

7. Basic material

A search through Spallanzani's papers could reveal whether this scientist based his publications on many scattered notes or on an organised collection of annotations, which made up a vast set of information. For example, Spallanzani wrote notes on the House Martin when he was still a university student in Bologna. Other observations on the Barn Swallow go back to the period when, after graduating, he was teaching at Reggio Emilia University, between 1755 and 1763. Furthermore, notes on Common and Alpine Swifts, Barn Swallows and House Martins are found in the 1785-86 period in the diaries he wrote whilst on his long journey and during his time spent in Constantinople, which were published posthumously a century later (Spallanzani, 1888) and were more recently revisited in detail by Mazzarello (2012). Therefore, we can imagine that when he decided to organise his notes in the *Appendix* to his *Voyages*, he had at his disposal material collected over a period of four or five decades. All these notes were properly dealt with in terms of both quality and quantity, considering the number of measurements that he had carried out in both the field and laboratory as well as making numerous references to

both contemporary authors and authors from before his time whose writings he either verified, confirmed or dismissed. Overall, in the *Appendix* to his *Voyages* of 1797 the five monographs make up a full-bodied text consisting of 146 pages. In addition, there are an extra 42 pages dedicated to the Scops Owl and 94 pages to the eels found in Comacchio, on the Adriatic coast, thus completing what he had previously written about the eels found in Orbetello, on the Tyrrhenian coast, in Tome V of his *Voyages*.

8. The expository method of the five Monographs

Each monograph is introduced by a kind of abstract summarising the main topics of the essay. Proceeding further, one would expect every single species to be analysed in detail in a single monograph, however this is not the case with Spallanzani. Seeing as all five species treated in this work share aspects in common which link them together with one another indirectly, several references and cross-comparisons with the other species of *Swallows* are found in each monograph. Therefore, the five essays should be rather regarded as a single treatise, subdivided into "chapters" that unfold progressively, passing from one species to another, despite the Author always maintaining a homogeneous vision. Furthermore, he thoroughly deals with topics of interspecific interest, such as the birds' loyalty to their nest and brood, their resistance to freezing temperatures etc. All together there are about one hundred cross-references (Ferri, 2020), which are more detailed in certain essays than in others. Very often, they are mere quotations for generic comparisons, despite there being important observations and measurements on single species as well, which are later described in the text regarding the following species. Over 60 references to other species of *Swallows* are concentrated in the essays on the Common Swift and Alpine Swift, but the reader should always remember that the five monographs are to be considered a single work, preferably read in the order established by Spallanzani.

9. An eclectic scientist anticipating his time also on swallows and swifts

As previously mentioned, Spallanzani published several texts regarding his experiments and conclusions he had drawn which, considering the time and age, are to be viewed as progressive and innovative. In *Dissertazioni di fisica animale e vegetabile* (1780) he shared his studies on artificial digestion in birds, insemination in amphibians and the role of gastric juices in humans. Two particularly interesting works are *Lettere sopra il sospetto di un nuovo senso nei pipistrelli* (1794), in which Spallanzani describes his tests on bats, concluding that their most fundamental organs were not the eyes but a non-recognisable

sense, exactly 144 years before the official discovery by American zoologist Donald Griffin (1959), thanks to his research on animal echolocation.

In his five monographs, Spallanzani describes many kinds of experiments performed on birds, which make him the most early and methodical forerunner of bird ringing, in this case more like "marking". Indeed, the bird ringing technique for recognising individual specimens was officially established much later on. In 1889, Danish ornithologist Hans Christian Cornelius Mortensen, whilst carefully monitoring the starlings (*Sturnus vulgaris*) which used to gather in large flocks in his garden, captured a number of specimens and fitted metal rings with progressive numbers and a postal address onto their tarsi, to see whether the same individuals kept coming back. Nevertheless, as early as 1797, Spallanzani described a series of experiments involving individual marking swifts and swallows by tying a silk crimson thread to their legs, in order to verify if the same specimens returned to the nest the following year. The same birds were then recaptured and inspected. In addition, in order to demonstrate the ability of Barn Swallows, House Martins and Sand Martins to return to their own nests, Spallanzani used to have them captured and released many miles away to check the departure and arrival time to their nests by means of synchronised watches. In one occasion, dealing with House Martins, he cut off some of their rectrices in order to recognise them.

On this subject, Spallanzani quotes also Book X of Pliny the Elder's *Historia Naturalis* (77 CE) which is a source of information on the custom of ancient Romans to mark swallows with coloured ribbons to exchange communications during sport events. Among the forerunners of modern bird identification, we find once more Edward Jenner (1749-1823), who experimented the swifts' fidelity to their nests by marking them by cutting of two of their nails. He followed their regular return to the nests for several years and one specimen was even found after seven years. It is a real pity, though, that these two scholars never knew each other.

Apart from disproving the belief that swallows spent the winter at the bottom of lakes and swifts in the cavities of buildings, Spallanzani also disproved the belief that sand martins spent the winter at the bottom of their tunnels, which was a well rooted belief even amongst scientists. He also pinpointed that this sort of belief even influenced Carl Linnaeus since he wrote that swifts *hybernant in templorum foraminibus* [*they winter in the holes of high buildings*] in his famous work *Systema naturae* (Linnaeus, 1758). It is surprising that even for a few decades after Spallanzani's studies, famous scholars like Georges Cuvier (1769-1832) still believed in swallows' underwater hibernation. Only in the mid-19th century was this belief completely dismissed thanks to a rich public contest, organised by the Royal Swedish Academy of Sciences, which promised a large reward to whoever managed to fish swallows out of the water in winter.

Initially, many people responded with great enthusiasm, but obviously nobody ever claimed the prize and the case was closed for good (Baldaccini, 2007). Finally, we need to point out Spallanzani's interest in bird migration, which he described in detail only in his monographs about the Scops Owl and the eels, although in his essay on the Sand Martin he leaves a precise testimony: «... *It is thought that the Sand Martin possesses some sort of ability or power that is awakened in certain periods of time, inducing the bird to change climate*». This remark was based on the observations of the behaviour of another species: the Common Nightingale (*Luscinia megarhynchos*).

10. Cruel experiments?

In Spallanzani's monographs, there are detailed descriptions of the experiments that he carried out by submitting each species of *Swallow* to meticulous endurance tests to very low temperatures. This was achieved by adding kitchen salt to the snow preserved in icehouses, then placing the birds inside baskets covered with an oilcloth, which in turn were buried in the snow. The experiments were accompanied by details on the vessels containing the birds and the times of exposure to cold. Invariably, these tests always ended with the death of the test subjects.

The purpose of these lethal trials can be justified by his urge to verify and confute the dominant belief in the scientific environments of his time that at our latitudes these birds hibernated in a sort of torpor. Although such acts would nowadays be considered cruel and unacceptable, considering the average human's sensitivity towards living creatures, we should appreciate the fact that Spallanzani also did direct and thorough inspections on buildings and bank tunnels to prove that his *Swallows* were not wintering at our latitudes. As proof of his views on nature regarded as important, it is worth recalling his comment on the effects of massive captures of starlings in large reedbeds near Rubiera (Province of Reggio Emilia). The trapping was carried out by the local people by means of large nets with the twofold purpose of getting food and reducing the damage that these birds caused to fruit trees and, in particular, to vineyards. He wrote: «*unfortunately, this procedure meant the death of a great number of swallows, which are birds that should be spared and protected considering their importance to humans, since they kill and eat mosquitos, flies, weevils and other harmful pests*».

11. Limits of Spallanzani's knowledge

Despite his progressive and innovative views and works and notwithstanding his many intuitions, even a meticulous devoted scientist like Lazzaro Spallanzani could not completely overcome the knowledge boundaries of his

time. Therefore, today it would be wrong to take his monographs literally, due mainly to certain naiveties. Furthermore, the limits of the scientific context of his era are easily recognisable, although with no substantial effects on the value of these booklets, which remain to this date extraordinary scientific essays even if they were written in the second half of the 18th century.

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Further information and publications on both Spallanzani and the swifts are available in the link below:
http://www.festivaldeirondoni.info/spallanzani_e_i_rondonin

Appendix

From the notice of Lazzaro Spallanzani to the readers[1]

The birds I am going to describe are various species of swallows and swifts, which are migratory in the Italian peninsula and non-migratory in the Aeolian Islands. Since for many years I have engaged myself in investigating the instinct, attitude and behaviour of these creatures, thanks to the information collected in the meanwhile, I was able to notice several mistakes about these birds made by some Authors who preceded me; therefore, I allowed myself to correct them. I also had the opportunity to clarify some controversial or doubtful issues, adding many new and relevant considerations with the hope of deserving the attention of the Public.

[1] This notice clarifies the motivations and purposes of the eight Monographs making up Tome VI, which is the Appendix to his work *Voyages to the Two Sicilies and in some parts of the Apennines*.

Monograph no. 1 by Lazzaro Spallanzani

"The Barn Swallow (*Hirundo rustica* Linnaeus, 1758)"

The Barn Swallow *Hirundo rustica* (photo by G.B. Gai).

Abstract

i) The Barn Swallow dwells inside our homes; ii) When it comes to nest; iii) Different times of arrival in the Lombardy plain compared with the surrounding mountains; iv) Noting whether cold spells occur after Swallows return v) Proof of the same birds returning to the same houses; vi) Variations in the young swallows born and brought up here; vii) After reproduction, these birds leave our homes, although they stay on longer in our area; viii) Their gathering in the evening on rushes and reeds in order to roost; ix) Their hunting for insects; x) The time when swallows leave our territory; xi) Examples of some stragglers that remain with us for months in winter without dying of cold; xii) Extremely cold situations created artificially in which swallows do not die; xiii) They can withstand severe cold much better, contrary to some beliefs.

Riassunto

Abitatrice dell'interno delle nostre case. Quando viene ad abitarle. Differenze nel tempo tra i piani della Lombardia e i monti che la attorniano. Come osservate in questa rondine, se dopo il suo ritorno nel nostro clima sopraggiungano acuti freddi. Prove sicurissime del ritorno dei medesimi individui alle medesime case. Eccezione nelle rondini novelle ivi nate ed educate. Dopo la figliatura lasciano

le nostre case, senza lasciare allora il nostro clima. Loro radunamenti la sera sui giunchi e le canne palustri, a fine di pernottarvi. Caccie ubertose, che se ne fanno. Epoca in cui le rondini sogliono partire dalle nostre contrade. Esempi di alcune poche rimaste per qualche mese d'inverno fra noi senza morire di freddo. Freddi grandemente più acuti fatti nascer dall'arte, nei quali non periscono le rondini. Possono sopravvivere contro le sue rigidezze più assai di quello che si sarebbe creduto.

By "Common Swallow", I mean the species which, in the right season, builds its nest inside our houses and which from now on I will simply call 'Swallow'. As we shall see, it can easily be distinguished from the other species of the same genus. It is such a well-known bird that it needs not describing.

In the vast plain of Lombardy, it arrives around mid-March. I said "around" since these birds might anticipate their arrival by some days if the weather is warm or, on the contrary, postpone it if the weather is still cold. This is not the case in the high mountains of the Apennines that surround the Lombard territory where they still breed, although in much lower numbers owing to the harsher temperatures. Indeed, in the mountains they do not appear until the end of April or even May. For the opposite reason, on the Genoa coast they can already be seen in early March.

It is worth noting that when the weather became warmer in Lombardy at the end of February or mid-March, I never saw a single Swallow, although I always checked carefully. This fact induces me to believe that they leave their wintering quarters only at specifically pre-arranged times.

Usually, after their arrival in Lombardy, they face low temperatures caused by the North and Northeast winds, which often bring snow and frost. If the cold does not last long, the Swallows remain, but they leave our areas when the cold persists. Consequently, we cannot doubt that they move to less harsh climates and I do not think I am wrong in saying that the Swallows of Lombardy move to the Genoa coast. In fact, several times in spring, when I moved to the Liguria Riviera from Pavia, I noticed that Swallows were in much larger numbers there than when Lombardy was struck by very low temperatures and therefore these birds could not enjoy the usual warmth. Once the harsh weather was over, they did not linger but went back to the places they had left a few days before since for such fast birds the distance between the skies of Lombardy and Liguria and vice versa is short. They are compelled to leave our regions not so much because of low temperatures but rather because of the lack of food, since they feed on small flying insects that hibernate on the ground due to low temperatures.

It has been proved that the Swallows that nest in a certain house faithfully return to it since at their return in the spring they still have the red thread that I had tied to their leg the previous autumn before their departure. I have applied

this method three times by tying a very thin silk thread to one of their legs. Two times, both males and females returned to their nests, thus proving their identity without doubt. However, the Swallows of the third experiment did not come back, although this does not mean that they had abandoned their nest since they might have died by natural or accidental causes.

Therefore, my observations prove that swallows always go back to the same houses and that the bond between male and female remains strong, as also happens with other bird species.

However, in order to avoid misunderstandings, only adult Swallows go back to their usual places, that is the specimens that had bred the year before, since most of the time their offspring go to nest elsewhere, as I was able to verify in the following case. In Pavia, under the portico of my own house[2], 6 or 7 pairs of Swallows regularly nest; they seldom repaired their nests in 18 years. Their numbers never increased, although they always raised two broods in the good season and the young ones always followed their mothers. I noticed the same thing in two Swallows which had their nest in a room of another house; the number of the nesting couples never increased, although they always completed their reproduction successfully. It is therefore obvious that, at least for the cases that I was able to follow, the young swallows do not build their nest in the same place where they are born. This is confirmed also by the fact that, from the beginning, the young Swallows show a clear need to go away from the places where they were born. After leaving the nest once they are able to fly, they follow their parents for a few days and in the evening, they go back in the same nest to sleep, as a family. But once they no longer require looking after and they can find food by themselves, the young Swallows disappear and only the adults remain to tend to the second brood.

Towards the end of August, once they have finished nesting, the Swallows leave our homes and their nests, although without going far. We can still see them every day here and there flying swiftly looking for food and gathering in small groups where their prey is more abundant or more easy to catch. In the evening we can see them roosting in great numbers on the rushes of some marshes and ponds, often in the company of other birds, such as the Starling (*Sturnus vulgaris* Linnaeus, 1758), the House Martin (*Delichon urbicum* Linnaeus, 1758) and the Yellow Wagtail (*Motacilla flava* Linnaeus, 1758). Many years ago, near Rubiera of Modena, hunting them was considered an enjoyable activity. Besides large numbers of Swallows, Wagtails and House Martins, numerous colonies of Starlings arrived from various directions, similarly to Carrion Crows (*Corvus corone* Linnaeus, 1758) in the winter,

[2] Since 1769, Spallanzani lived in Pavia first in via San Martino, near the Castiglioni College, then, between 1770 and 1778, he resided in the ex-convent of Sant'Epifanio, which at present is the seat of the Botanical Garden of the University.

which gather around Pavia in the woods along the bank of the River Ticino. At sunset, the afore-mentioned Starlings gathered on top of tongue-shaped reeds near Rubiera, which in the middle had been deliberately cleared by hunters with a small body of water surrounded by a very large net. In the middle of the night, the reeds were crossed by a rope which, pulled by the strong arms of several men, shook the reeds. This sudden movement and the noise frightened the birds, which moved towards the pond where the reeds were still. At this point, the rope was quickly pulled and consequently a great number of birds flew over the body of water to go and roost on the other side. As the birds flew over the pond, the net was dropped on them so that they remained trapped, falling into the water and drowning shortly after. This sort of hunting did not occur just once but many times thanks to the new arrival of species that continued to crowd the reeds. In this way, large numbers of Starlings were caught, which was a useful thing considering the damage that these birds cause to fruit trees and, in particular, to vineyards. At the same time, these birds, once caught, were rather good to eat. Unfortunately, this procedure meant the death of a large number of Swallows, which are birds that should be spared and protected considering their utility to humans, since they kill and eat mosquitos, flies, weevils and other harmful pests.

It was reported that in some areas of France Swallows usually gather on top of very tall trees in groups of three to four hundred individuals. This occurs early in October and their departure usually takes place during the night[3], although sometime it happens during daytime[4]. Indeed, Mr Hébert[5] saw them many times as they left in small groups of forty to fifty individuals flying high in the sky towards the South in a very quick and compact manner (*ibid*.[6]).

This is a good observation, although I never experienced it in Lombardy or in the mountains that border to the South[7]. Indeed, I always noticed that before the end of September their number dwindles and soon after most of them disappear without gathering first. I said most of them since some, very few, remain with us till the beginning or even the heart of winter. To this purpose, I will describe some cases that I consider important owing to the consequences resulting from them.

The first episode took place on 11th November 1791. Throughout the whole morning, a thick fog covered the sky of Pavia. In the afternoon, the fog started

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[3] Actually, the various species of swallows are migratory birds with daytime behaviour.

[4] Note by Spallanzani: Montbeillard, *Oiseaux*, Tom. XII in 12. Cited now as P. Guéneau de Montbeillard, 1779, in: G.L. de Buffon *Histoire Naturelle des Oiseaux*, Buffon & Montebeillard, 1770-1783, VI.

[5] René-Joseph Hébert was a French high state officer but also a naturalist and a hunter. He corresponded with Buffon who quoted him frequently in his *Histoire naturelle*, thanks to his information on birds.

[6] Abbreviation of *ibidem* in Spallanzani (meaning "in the same place"), here referred to the previous quotation: Montbeillard, *Oiseaux*, Tom. XII in 12.

[7] The Northern Apennines.

to lift and within an hour and a half, the sun was shining. Then, over my house, located in the higher part of the city, I saw two Swallows flying low in wide circles, which is typical for these birds, and disappearing in the distance. Two nights before, I had noticed a thin layer of black ice on the streets but when I saw them flying, my thermometer read nearly +6.5[8] °R [8.12 °C]. Never again during that winter did I see these birds.

Once more, on 9th January 1785, two hours before dusk, I noticed a Swallow flying low, nearly touching the streets of Pavia. I was indeed surprised since, in that moment, the thermometer read -1 degrees and the night before it had reached -2.5 degrees. This bird was not flying with the usual agility and speed which are typical of Swallows; in fact, it was slow and looked very weakened. The sky was clear and there was no wind.

Finally, the third episode concerns something that I observed several times when I was professor of Philosophy at the University College of Reggio Emilia. In this town, the basilica of the "Beata Vergine della Ghiara" [Blessed Virgin of the Ghiara] is famous for its impressive architecture, size and beautiful paintings. It is quite common that in the mild season a Swallow got inside this church through the main door, which is very wide. Nevertheless, once inside the bird could not find the way out. Therefore, it flew higher up, where there is more light, as observed also with other birds, which were caught in and struggled to find a way out toward the top of the dome, which is large and bright. This big dome, though, turned into a maze for the Swallow, which could not get out anymore and continued to fly incessantly until it was so tired to rest on top of the protruding cornices.

Sometimes I was able to see some of them until mid-January. I could not understand how they could survive without feeding, since inside the church the food consists only of flies, small spiders and other tiny invertebrates. Furthermore, in this specific case, the Swallows trapped inside this building had to feel the cold during all winter, since the dome had numerous and wide windows protected only by glass.

These observations convinced me that, contrary to what most people generally believe, Swallows do not feel the cold to the point of fleeing away from the winter and returning when it is over. Similar things are in agreement with the statement that, once Swallows return here in the spring, they do not go away when they are caught by low temperatures, provided that the cold spell does not last long. In Lombardy, towards the end of March and even in early April sudden snowfalls may occur, although rather seldom, during which I was able to see Swallows more than once flying around with no sign of being harmed or even bothered by the snow. And if the Swallows move to the milder

[8] Spallanzani used the Réaumur scale (°R), whose conversion factor is 4/5 (that is 80 Réaumur degrees correspond exactly to a 100 Celsius degrees).

climate of Genoa when the cold persists, as I was able to verify, they still have to withstand much harsher conditions when crossing the high Apennine passes without dying.

This series of verified observations, nonetheless, is in disagreement with what is reported at the entry "Swallows" in the *Encyclopedie Méthodique*[9]: "When cold spells occur in springtime after the arrival of swallows, these birds die during the day at temperatures of +4 or +5 degrees, and of -1 up to -2 degrees if they are exposed to the cold weather for one or two hours before sunrise". Therefore, I wanted to satisfy my curiosity by preparing for some Swallows cold artificial conditions, and I carried out the experiment on 21st August 1792 when the thermometer read +19.5 degrees. I put four Swallows inside a cylindrical glass vessel that was immersed in the snow for a full hour. At established intervals, I got the Swallows out and noticed that they gave no sign of being numb. Indeed, an hour after I took them out of the vessel and let them free in the room, they began to fly, although more slowly at first. Then I submitted them to lower temperatures after mixing sodium chlorine with snow. I placed the vessel with the four Swallows into this mixture next to a smaller container with a thermometer inside in order to verify which temperatures they could withstand. After 183 minutes, it read -10.14 degrees and the four Swallows looked weak but still alive. They kept their eyes open and, if touched, they moved inside the vessel. When eventually I removed the cloth cap that sealed the container, they made efforts to flee from the opening. The thermometer did not go below this temperature, always remaining at -10.14 degrees. I left the Swallows at this temperature, which can seldom be attained even in the coldest winters and now and then I removed the cap in order to examine their conditions. After another 60 minutes, I checked the Swallows again and noticed that two of them still showed signs of life whereas the other two looked dead since, although I poked them with a wooden stick, they remained with their eyes shut and head tilted and did not show any sign of spontaneous movement. This happened when they were inside the vessel, even by taking them back to room temperature which, at that moment, was +19.33 degrees. Actually, what happened was nothing more than asphyxia since, once exposed to a warmer temperature, they revived and, after another 68 minutes, they became active and lively like before. The other two, after another 11 minutes at those low temperatures looked dead like the others, but they quickly recuperated their original liveliness once they were brought back to room temperature.

[9] *Encyclopedie* Méthodique, by Louis-Jean-Marie Daubenton (1716-1799).

After the four Swallows had recuperated their strength, I put them back in the vessel and brought them again to the same temperature of -10.14 degrees, which they withstood for another 19 minutes without dying. At this point, I could not continue the experiment since the temperature had gone up due to the snow melting.

On 27th May 1793, the experiment was repeated on other Swallows using the same method, although this time a lower temperature of some degrees was reached. One of these birds, after withstanding for 10 minutes a temperature of -11 degrees, was removed from the vessel and looked very weak indeed. After another 15 minutes at the same temperature, it was freed in the room where at first it managed to fly but soon after it fell to the ground. Once the amount of snow and sodium chlorine was increased, the thermometer went down to -13.5 degrees and the same Swallow was kept in this severe cold for another 10 minutes after which it was found barely alive and panting. After another 8 minutes, the bird was dead.

On the same day, another similar experiment was carried out on another Swallow that looked very lively, like the previous one. Nevertheless, after 15 minutes at -14 degrees it was found dead inside the vessel.

The exposure to the same temperature for 10 minutes killed a third Swallow which, when placed inside the vessel was lively like the previous ones. Nor could I state that these Swallows suffered from temporary suffocation, since when they were removed from the vessel they never revived.

Thanks to these experiments, it is clear that Swallows die when exposed to intense cold, but they can withstand lower temperatures at which it is commonly believed that they would die.

Monograph no. 2 by Lazzaro Spallanzani

"The House Martin (*Delichon urbicum* Linnaeus, 1758)"

The House Martin *Delichon urbicum* (photo by M. Giordano).

Abstract

i) Extremely common species all over Italy, although Montbeillard thinks the opposite based on the authoritative opinion of Aldrovandi, who believed this species to be absent in our territory; ii) The House Martin usually nests mostly in areas inhabited by humans; iii) It arrives in springtime, although later than the Barn Swallow, and builds new nests if the old ones have been destroyed; iv) A tale told by Linnaeus, who wrote that sometimes the old nests are occupied first by Sparrows; v) Material used for the construction of nests and the birds' intelligent method used for building; vi) How to catch them when they are busy collecting nest material; vii) Their attachment to their offspring, which is not linked to local situations, as some people believe; viii) Various factors demonstrate that these birds feel the cold; ix) How, by means of a House Martin sitting on eggs or feeding its fledglings, it is possible to receive or send messages to friends far away in a short time. Similar experiments have been made with Swallows. This cannot be done in similar circumstances with other birds with less agile flying skills; x) How House Martins are sensitive to moderate cold but can withstand severe temperatures before dying.

Riassunto

Si tratta di una specie abbondantissima quasi in ogni angolo d'Italia, sebbene Montbeillard pensi il contrario, basandosi anche sull'autorevole parere dell'Aldrovandi il quale affermò che questa specie

nelle nostre zone non sarebbe presente. Tende a fare il nido più nelle zone abitate dagli uomini che in quelle disabitate. Arriva in primavera, ma più tardi delle Rondini, e costruisce nuovi nidi solo se sono distrutti quelli vecchi. Fantasioso racconto di Linneo, a proposito di quando capita che i vecchi nidi vengano occupati prima dai passeri. Materiali utilizzati per costruire i nidi e il modo intelligente di metterli assieme. A proposito del modo di cacciarli, quando sono occupati a raccogliere i suddetti materiali. Sull'attaccamento verso la prole che non è legato a situazioni locali come certi ritengono. Diversi fatti dimostrano che questi uccelli soffrono il freddo. Come tramite un Balestruccio che cova o imbecca i piccoli si possano ricevere o trasmettere messaggi ad amici lontani, in poco tempo. La stessa cosa sperimentata con le Rondini. Nelle medesime circostanze lo stesso non si può fare con altri uccelli meno abili al volo. Sebbene i Balestrucci siano sensibili ad un freddo moderato, prima di morirne possono sopportare temperature ben più rigide.

As in many other parts of Italy, I shall also call the swallow with a black-bluish rump and white abdomen "House Martin", which Linnaeus classified as *Delichon urbicum*.

I was surprised to read that Aldrovandi[10] considered this swallow absent in Italy, or at least in Bologna[11]. I would like to believe that when this famous naturalist was writing there were no House Martins in his town, although when I lived there as a student, I saw many nests of this species under the roofs of several houses. If we consider the whole of Italy, it is well known that House Martins are more numerous than Barn Swallows and Swifts. Indeed, there is hardly any town or village in the plain as well as in the hills or mountains where the House Martin does not breed in great numbers. Among the many Italian towns that I visited, I noticed that these birds were missing only in Venice where, by the way, there are not many Barn Swallows either, although the climate is favourable and the buildings suitable for their nests. I tried to find an explanation, and I think the reason is due to lack of food, since they feed on flies, gnats, small moths and other flying insects, which are not present in Venice, as I was able to verify myself when I went there on different occasions during the suitable period for breeding. The city's inhabitants also confirmed this fact. Without doubt, the absence of these small insects is due to the fact that they cannot lay their eggs in a place nearly completely covered by salt waters.

Montbeillard[12], in his "Natural History of Birds", remarked that the House Martin breeds preferably at the entrance of caves, on rock cliffs and steep slopes, instead of brick walls; therefore, it would prefer isolated places rather

[10] Ulisse Aldrovandi (1522-1605) was professor of Logic and Philosophy and later of Natural History at the University of Bologna. He is credited for the invention/first written record of the word "geology".

[11] *Caret huiusmodi hirundine Italia, vel saltem hic* [that is in Bologna] *mihi nunquam observare licuit* (cf. Aldrovandi U., 1599 – *Ornithologiae*, T. II, Bononiæ).

[12] Philippe Philibert Guéneau de Montbeillard (1720-1785) was a French writer and naturalist who collaborated with Buffon by editing Volume 6 of his *Histoire naturelle des Oiseaux*.

than towns or urban areas. This was first confirmed by Hébert (a talented French ornithologist), who described the House Martins that abound around Nantua[13] and which prefer to build their nests on the sheer rocks surrounding the lake with the same name, although they could find suitable breeding sites in the town. This fact might even be true, although it should not be generalised. For instance, the Castle of Scandiano is greatly favoured by this species of swallow, which builds its nests on top of a high tower. Nests are also found outside certain houses facing North and East, on the upper part of the walls of the Capuchin Convent, but also the South face of several buildings has always been occupied by groups of 2, 3 or even 4 nests. At 2.5 miles[14] Southeast of this castle, in the Apennines, there are two steep cliffs, called "Ripe del Sasso" and "Ripe della Scaffa"[15]. They have many cavities and ledges that could be suitable for House Martin nests since they would protect them from the rain, as it is the case with houses. Nevertheless, no nests were ever found in the cliff and very few in the latter.

During my numerous excursions in the Apennines, I often visited similar sites, although I never found them populated by these little birds. On the contrary, I often found their "dwellings", that is their nests, in the villages and hamlets more or less near these cliffs.

In July 1788, as I was going to Rome, I passed by Foligno[16] and was surprised by the number of House Martins that were building their nests under the eaves of the houses of that town and in the villages nearby, whereas in the nearby hills there was none.

I should specify, though, what I observed in the mountains above Fanano, a large village of the Province of Modena. On the steepest slopes, there were clouds of these birds. Therefore, the buildings of Fanano were a curiosity for an ornithologist eager to solve this little riddle. In fact, these houses should have been without nests, like those in Nantua, if we accept the statement by Hébert that House Martins prefer the nearby cliffs. On the contrary, there are plenty of nests in these houses, at least in those that seem most suitable for them.

Therefore, I do not really agree with Mr Montbeillard when he states that this species of swallow prefers lonely and isolated sites to town centres. If this sometimes occurs, I think it depends on local conditions, such as the fact that the food is more plentiful in one place rather than in another.

This esteemed French Author points to the fact that in France House Martins arrive 8 or 10 days after Barn Swallows and that, at the beginning, they stay

[13] Nantua is a town in the Ain Department, south-eastern France.
[14] About 4 km.
[15] Both these cliffs are no longer traceable.
[16] Foligno is a small town in the Province of Perugia.

along watercourses and in marshy areas. His first statement is valid also for our territory, whereas the second one is not true, since in our areas House Martins go straight to their nests, even in villages that are not surrounded my running or stagnant waters, as in Pavia. On the other hand, Barn Swallows do not behave like this; at least those that have their nests in this city since, after their arrival, they fly around them for several days before occupying them.

As for cold spells in the spring, it was proved that if the cold lasts for a long time they leave, but if it lasts only for a short time, they remain with us.

It was said that House Martins which dwell on cliffs or isolated places rebuild a new nest every year. I was not able to verify this, but I ascertained that things go differently over here, where the House Martins that nest in houses have the habit of reusing the same nests for several years; other people observed this too.

Linnaeus writes that the House Sparrow (*Passer domesticus* Linnaeus, 1758) can often occupy a House Martin's nest. If this happens, this swallow gets the help of members of its own kind, some of which keep the intruder still while others bring clay in order to seal the entrance to the nest. In this way, these Martins take revenge by suffocating the intruder (*Syst. Nat.*[17], *Hirundo urbica*).

This tale is amusing and is still used by its illustrator Mr Gmelin[18], but common sense tells us that it is not true. Indeed, it has happened that the House Martins arrived some of their nests were already occupied by sparrows. In these cases, House Martins fly and shriek around the occupiers but they never do anything like what was said before, so much so that the intruders remain in the nests. In addition, the sparrows put many blades of straw and grass, twigs and other recovered material which makes the nest unsuitable for House Martins, since they would be in their way because of their short legs.

The shape of the birds' nests is an important element in their life. Each species builds a particular nest, different from those of other species and keeps it unchanged, generation after generation. The shape of the legs and of the bill and the way they use them are the tools of these hard workers. The materials used by House Martins and Swallows are more or less the same, that is earth, straw blades and feathers, although they differ in the shape. Both have the appearance of a semi-sphere, but the House Martin's nest is wider with a smaller opening.

The above quoted Montbeillard says that he has found bugs[19] inside the nests. I observed the same thing: nearly all the nests examined had these

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[17] *Systema Naturae* (1735-58) by Carl Linnaeus. This work marked the adoption of the systematic use of the binomial classification of plants and animals (*Genus* and *species*).

[18] Johann Friederich Gmelin (1748-1804) was a German naturalist.

[19] Several species of parasite insects and mites are present in these nests.

parasites and I counted 47 of them in just one nest. These revolting and rotten insects look the same as those which infest the houses of humble and poor people, although sometimes they are found also in the homes of cleaner and noble people. These parasites usually hide in an impalpable dust, quite common inside these nests, and they are full of blood which they sucked from the House Martins, especially from the fledglings that are compelled to stay in the nest until they are ready to fly. In any case, notwithstanding this parasitism, the *pulli* are always very fat.

A fine layer of feathers that is found also in the nests of Swallows and other birds, covers in turn the dust found inside the nests. Obviously, the parents collect these feathers in order to keep their eggs warm and their brood comfortable.

Mud makes up most of the material of a nest. House Martins collect it with their bill along the shores of rivers, streams ponds etc. whereas on the dry land they collect sticks, straw blades and other tiny material that are found inside the nests. Feathers, though, are collected in mid-air, at least the lighter ones, which are carried up high by the wind when they detach from the birds' body.

I witnessed this way of collecting feathers when I was very young and, by observing their behaviour, I learned how to catch them. I put some birdlime on a 1-inch[20] long twig of sorghum and I glued it askew to a very light feather. Then, I went on top of the building near which the birds were flying and started to blow on the feather to make it move up and down, and most of the time it was swept up by the wind. On seeing it, a House Martin would come to catch it but, when it touched the feather, its wings would be stuck in the glue and the bird would fall to the ground. In places where great numbers of House Martins used to gather, I was able to catch a few dozens of them in less than one hour. Watching this sort of hunting was not at all tiring and very pleasant for those who stood by, but it also amazed those who did not know about the trick of the birdlime and saw the House Martin falling to the ground at the only touch of the feather swinging in the air. However, this stratagem can work only before the nests are filled with feathers, although some interest for new feathers remains. Otherwise, after brooding and once the eggs hatch, feathers are no longer useful for the birds since they lose interest and stop collecting them.

Usually, the House Martin raises three broods: the first one within May, the second one in June and the third one within July. Montbeillard, who had been observing them before me, asserts that the first brood consists of five eggs, the second one of three and the third one of two or three.

I think that his observation is true only in particular cases because it would

[20] The inch ranged in Europe from 2.60 to 2.708 cm. The metric system was adopted only in 1798.
[99] under Napoleon. Up to then, measurement units varied from country to country and sometimes within each of them.

not be reliable if applied to all birds. At the right period of time and for several consecutive years, I examined the number of eggs of the first, second and third broods and I realised that the number of eggs remained the same in all of them (usually five or six eggs). During the summer holidays of 1793 in Scandiano, I examined the nests of the afore-mentioned Capuchin Convent at the end of July where, on the North, East and South sides over one hundred nests formed a sort of thick rope all around the outer walls. I noticed that although the young ones were still in the nests, they were able to fly. In fact, when I checked the nests one by one, nearly all the chicks flew away and their way of flying was identical to that of their parents. Moreover, every brood consisted of 4, 5 and sometimes 6 chicks.

Since I took note of the incubation time, I think I am right in saying that it lasts 15 days and that extra few days are necessary for the parents to wean the chicks. Thus, within 3 months the females raise three broods.

But I wonder if it is true, as stated several times by the French Author, that these birds never build their nests inside the houses and that the bond with their own offspring depends somehow on local situations. With respect to the first statement, I certainly agree since I have always seen these birds building their nests outside buildings and never inside, as Barn Swallows do. However, I do not share his second opinion because my observations showed opposite results. Indeed, Montbeillard had detached a House Martin nest with four chicks inside and placed them on the windowsill of a window next to the nest. Their parents kept flying close to them but did not take any interest in their offspring although they certainly heard their calls.

I could not say why they did not take any notice, nor if this depended upon the fear of humans who might be looking through the window or other reasons. I can only state that when I placed the chicks of many broods inside a cage next to their nests that had been detached from the original position, their parents always kept feeding them even after they were able to fly. Therefore, this parental bond does not depend on the position of the nests, but links together parents and offspring even though the latter had been removed from their nests.

When circumstances allow it, House Martins build many nests in the same place because they are sociable by nature. They also feel the cold and in summer, early in the morning, they gather in large groups on the cornices of towers and on the tallest buildings facing East so they can warm up in the rays of the rising sun. As autumn approaches, accompanied by showers of rain and cold winds, all the House Martins of a certain village, or nearly all of them, fly towards the ledges of the tallest building, exploiting the most favourable position to find shelter from the rain and the wind. In these places, they stay very close to one other and are so cold and torpid that it is not difficult to catch them with your bare hands.

I myself experimented this for several consecutive years, towards the end of August, on top of a high tower in the province of Modena. These birds gathered in large numbers on the South and West faces of a wide ledge when the rain came from the North or Northwest. Since there were several windows just above this ledge, I was able most of the time to catch a handful of them by quickly stretching out my hand and arm, since they looked as if they were frozen. I noticed that most of them kept the head under their wing or leaning on their back as if they were asleep. Since this sudden capture frightened them, they fled if they could by flying very fast.

After having completed their last brood of the season, House Martins stay well beyond mid-September. Some of them continue to spend the night in their nests, but the majority of them go to sleep on the reeds of ponds together with Barn Swallows.

After this time, they fly away without gathering in large clusters. Seldom, at the beginning of winter, some stragglers are seen in Lombardy, although they are doomed to succumb to the coldest season. Therefore, our House Martins behave differently from those observed by Hébert, who reported that these birds gathered in large numbers on a building in Bria[21]. Furthermore, Lottinger[22] asserted that before their departure House Martins train themselves by flying high, nearly as far as the clouds (Montbeillard *l. c.*[23]). The local characteristics of Lombardy and of the other places previously mentioned are perhaps the reason for the differences observed, since they may influence animal behaviour.

I did not check whether House Martins reoccupy the same nests they had built the previous year, when they come back in the warmer months. Nevertheless, I did an experiment just as interesting with Barn Swallows about their typical behaviour. When one wishes to receive quick news from a distant friend, a Swallow engaged in hatching is sent to him. After receiving the bird, the friend would again let it free after having tied a thread of a previously established colour to the bird's leg. The Swallow is then eager to go back to its nest and arrives there much faster than a man would, bringing back the coloured thread with the reply. Even Pliny[24] provides us with more than one example of this. In order to verify the same thing with House Martins, I behaved in the following manner. I had some of them seized from a country house in the Modena area, when they were feeding their offspring, then I cut off some feathers of their

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[21] Meaning the town of Briançon in the Hautes-Alpes Department, south-eastern France.

[22] Antoine Joseph Lottinger (1725-1794?) was a French naturalist who contributed to the *Histoire Naturelle des Oiseaux* by Buffon.

[23] *l. c*. (also *loc. cit.*; less common *l. cit.*): abbreviation of the Latin words *loco citato* (quoted locality), redirected to Montbeillard in Buffon & Montebeillard, 1770-1783, VI.

[24] Pliny the Elder, Gaius Plinius Secundus (23-79 CE) was a famous Roman scholar and naturalist, author of *Naturalis historia*.

tails and I had them transported to Reggio, which is 7 miles[25] away, where a good reliable friend of mine would let them free. Indeed, they always came back quickly to their nests with the throats full of food for their chicks, and the tail with the cut feathers was the proof of it.

To this purpose, a curious fact should be reported occurring to the Capuchin friars of Vignola, a small town at the foot of the hills which is 15 miles[26] away from Modena. Those friars had the habit of presenting every year a few dozen House Martin fledglings, caught from the walls of their convent, to a gentleman from Modena. In order to avoid them escaping, they used to catch them at night, when they were inside their nests. Once the person in charge of carrying them to Modena at night-time, inadvertently let them escape, since the hatch of the cage that contained them had not been closed properly. Immediately the young birds flew back to Vignola, arriving there before sunrise, when the friars were engaged in singing praises. These devout men then heard the calls of the House Martins, which had been sent away the night before and at daylight they were able to see them flying in and out of their nests. This tale, reported to me by some of those friars, is quite credible, although I think that together with the fledglings some adult individuals were also picked since it is difficult to believe that fledglings who are unfamiliar of their whereabouts could go back to their nests, especially in the middle of the night.

Some years later, when these birds were busy raising their offspring, I tried a similar experiment, having some individuals taken to a distance of 15[19] miles from the place where they had their nest, where a good friend of mine freed them. Their return to the nest was extremely fast. Once I freed some of them myself, because I wanted to observe their flight and the direction they went in. As soon as I freed them from my hands, they released a call as of happiness and, similarly to hawks, they started to fly in circles, at first narrow than wider, flying higher and higher until they nearly disappeared from sight. Then, they went off in the right direction towards their nest with a fast and steady flight.

Therefore, it is clear that this bird, once freed and once again master of the sky, flies high to find its bearings and recognises the way to its nest. For sure, its sharp eyesight allows it to identify the place where its offspring is from such a height. By facing that direction with its eyes and wings, it reaches its destination at maximum speed.

These descriptions make us understand why these birds and other similar species have been observed in some parts of Europe as they flew to great heights before leaving those regions and heading South. Such heights, which are far much higher to the altitude they usually reach when they frequent our houses, are undoubtedly performed to observe the details of the landscape

[25] 1 mile is 1.609 km; 7 miles are about 11.30 km.
[26] 15 miles = 24.10 km.

from a long distance and therefore direct themselves towards their destination without fear of getting lost.

What has been said on the ability of Barn Swallows and House Martins to return faithfully to the nest from which they were taken during the brood, can easily be extended to Swifts, which I will describe in another Monograph. Indeed, I believe that since Swifts are faster than these two species, they can cover a distance of 60 miles[27] in 15 minutes. This ability was experimented also with Kites and other birds that fly high and which could carry messages quickly over long distances.

I applied this sort of experiment also to a Feral Pigeon [*Columba livia domesticus* Gmelin, 1789] when it was feeding two chicks. The test was carried at a distance of 7 miles but the bird did not come back. When it was freed, it did not fly high like the Barn Swallows but moved around with an irregular flight close to the treetops and soon disappeared from the sight of the person charged with freeing it. The reason of the difference of behaviour between this pigeon and the Barn Swallow is very clear. Indeed, the Feral Pigeon is a sedentary species and does not go away from the place where it was born. Even if it sometimes flies to certain heights, it always remains within the borders of its territory. If it is removed from its own area, the Feral Pigeon gets confused and can hardly find the way back home. On the other hand, Barn Swallows are migrating birds with long wings and fast flight and, as such, they can attain great heights, thus recognising how to go back to the place where they were born, even when they are taken far away from it.

I also mentioned speed among the various features of the House Martin since the mere fact of being a migrating bird could not explain its behaviour. Otherwise, the same thing should be true also for birds such as the Common Quail (*Coturnix coturnix*), Common Nightingale (*Luscinia megarhynchos*), Blackcap (*Sylvia atricapilla*) and Golden Oriole (*Oriolus oriolus*), which seems impossible to me.

We have seen that House Martins feel even slight cold, which accompanies the first autumn rains when the thermometer reads at most +10 degrees Celsius. One could therefore presume that the exposure to much colder temperatures, such as those next to the freezing point, would kill them, but we proved that this is not the case. As I submitted Barn Swallows to intense artificial cold (see Monograph no. 1), I also submitted two House Martins at the same time and at the same conditions. On the 7th May, the first bird resisted for 10 minutes to a temperature of -13 without dying, though it looked without any strength, with ruffled feathers and stooping down wings. It died after another 11 minutes at the same temperature. The second House Martin underwent the same experiment

[27] 60 miles = 96.50 km.

on the same day and showed signs of weakness after an exposure of 15 minutes to a temperature of -13.5. After 10 minutes at the same temperature, it was panting and, after another 10 minutes, it was dead. This proves that House Martins, similarly to Barn Swallows, can withstand low temperatures well.

Monograph no. 3 by Lazzaro Spallanzani

"The Swift[28] (*Hirundo apus*)"

The Common Swift (*Apus apus)* (photo by M. Giordano).

Abstract

The Swift returns to us later than the House Martin and the Barn Swallow. Such a late arrival may be due to a greater fear of cold weather than in the other two species of swallows or, more likely, because it can catch its food later in the season. Swifts coming back in springtime to our climate return to the same nest sites they have used in previous years. In reusing old nests, they are not forced to build new ones. The structure and materials of these nests. Swifts' basic instinct to fly towards objects in the air and how it is possible to catch them. How, whenever they can, they like to nest in towers and high buildings. They will also place their nests in ordinary sites such as the dovecotes so common in most parts of Lombardy. Because of this, it has been possible to make exact observations about these birds which could not have been researched in other ways. They neither land on the ground nor perch in trees, they mate inside their nests. Facts observed during such a mating. They show no interest in escaping from sites where they are nesting if discovered by man. Whether this lack of concern stems from unawareness or instinct. False that in terram decidentes non avolant[29]*, as stated by Linnaeus.*

[28] The Swift, known as *Hirundo apus* in the 18th century, is nowadays classified as the Common Swift (*Apus apus*).

[29] Translation: "Once they fall to the ground, they cannot fly off" (cf. Linnaeus C., 1758 – *Hirundo apus*. In: "Systema Naturae").

Normally they have a single brood each year. How, after sunset, the males fly high in the air, stay up all night and return to the nest at the beginning of the day. It is not the case, as stated by a famous ornithologist, that the hatched pulli have no begging call. Females do likewise as males, resting high all through the night once they no longer need to warm the pulli. Hypothesis as to why Swifts stay high in the sky at night. Considerable period of time needed by fledglings to exit the nest and fly. Conclusion as to the reason for this. Nature acts in different ways in relation to different kinds of birds. During the hottest hours of the day in the summer, they stay hidden in the holes of towers and other buildings. The morning and evening hours are more suitable for flying in large flocks around the sites where they guard their precious broods. Unique status of young Swifts just before fledging, at their very fattest and heavier than their parents, but this characteristic is not seen in similar species. The reason for this characteristic. After fledging, adult and young Swifts disappear from view but they do not leave our climate. For some months, they inhabit the highest parts of the mountains avoiding landing. The speed and endurance of their flight is of a higher performance than most species of birds. The incredible accuracy of their eyesight. Approximate calculation of the distance from which a Swift can clearly recognise a flying insect. Swifts do not winter inside the crevices of buildings, as Linnaeus believed. Lack of food drives them away from our countries during the autumn rather than the cold. Swifts submitted to different conditions of artificially created cold temperatures.

Riassunto

Il Rondone arriva dalle nostre parti più tardi del Balestruccio, nonché della Rondine. Se questo arrivare più tardi sia dovuto al fatto che il Rondone vuole evitare il freddo, che teme di più rispetto alle altre specie di Rondoni, o più che altro per trovare il giusto tipo di alimentazione. I Rondoni tornano in primavera dalle nostre parti e negli stessi siti di nidificazione dell'anno precedente. Tendono a riutilizzare i vecchi nidi se sono ancora messi bene, altrimenti, se sono rovinati ne costruiscono di nuovi. Struttura e materiale di questi nidi. Particolare è l'istinto dei Rondoni che li porta a volteggiare in carosello per il cielo, volando insieme in stormo nell'aria aperta. Come grazie a questo istinto si riesca a catturarli. Per quanto prediligano nidificare sull'alto delle torri, e di altri imponenti edifici; tuttavia, nidificano anche in costruzioni più umili e basse, quali ad esempio le colombaie, così frequenti in più parti della Lombardia. Grazie a questi siti di nidificazione è possibile effettuare delle precise osservazioni scientifiche, che sarebbe impossibile fare in un altro modo. Dato che i Rondoni non si posano né sulla terra e né sugli alberi, è necessario seguire i loro accoppiamenti nei nidi. Cose osservate in queste circostanze. La loro noncuranza di scappare dai fori dove hanno i loro nidi, se vengono sorpresi dagli esseri umani. Se questa disinvoltura derivi dall'ottusità dell'istinto naturale. È falso che in terram decidentes non avolant*, come afferma Linneo. Di solito non procreano che una nidiata all'anno. Come, dopo il tramonto, i maschi si levano in cielo e vi stanno per tutta la notte a caccia di cibo e non ritornano ai nidi che all'alba. Non è vero quanto afferma un valente Ornitologo, che i pulli usciti dall'uovo siano privi di grida di richiamo. Le femmine fanno lo stesso gioco dei maschi di volare in cielo per tutta la notte, in modo che i pulli non hanno bisogno di essere riscaldate da loro. Congetture sulla ragione del soggiorno notturno dei Rondoni nelle parti elevate del cielo. Tempo assai notevole affinché i pulli escano dal nido e volino. Ragione finale di questo fenomeno. La natura procede in modi diversi a seconda della specie di uccelli. D'estate nelle ore più calde del giorno si tengono nascosti nelle buche pontaie delle torri, e di altri edifici. Le ore del mattino e della sera sono le migliori per volare in grandi caroselli sonori attorno ai luoghi dove custodiscono*

gli amati nidi. Singolarità nei giovani Rondoni non ancora usciti dal nido, in quanto sono molto più grassi e più pesanti dei genitori, e il suddetto fenomeno si estende però, sebbene con diversa proporzione, alle specie congeneri. Quale esser possa la ragione di tale peculiarità. Dopo la schiusa delle uova e il primo volo si dileguano da noi i Rondoni giovani e vecchi, non allontanandosi però subito dal nostro clima. Per più mesi abitano le cime dei monti, senza mai posarsi su qualche luogo fisso. Il loro volo, per la rapidità, e per lunghissima resistenza è il migliore rispetto a quasi tutte le altre specie di uccelli. La loro incredibile acutezza nel senso della vista. Si calcola presso a poco la distanza, da cui scorgono con distinta chiarezza un insetto volante. È falso che i Rondoni svernino dentro ai fori degli edifici, come credeva il Linneo. La mancanza di cibo piuttosto che il freddo li scaccia in autunno dalle nostre contrade. Rondoni sottoposti a diversi gradi di freddo procurato per esperimento scientifico.

There is more I need to record in this Monograph than in the two previous ones [translator's note: which were about the Barn Swallow and House Martin]. In many Provinces of Italy, we call "Swift" that species of swallow which is bigger than the other two, with some white on its throat and dark body. Aristotle called all kinds of swallows *apodes* because he either wrongly believed that they were without feet or, perhaps more realistically, he had noticed they scarcely made use of them. In any case, the term *apus* was used by Linnaeus to strictly refer to the "Swift".

Just as the House Martin returns to us 8-10 days later than the Barn Swallow, the Swift arrives even later after the House Martin. In fact, this migrating bird is the last one to arrive; all the Swifts return amongst us between 5th or 6th of April to around 25th April, sometimes even later. I do not believe that this swallow fears the cold weather more than the others do because I have shown how they tolerate it without dying.

My guess is that they are dependent on the insects on which they feed late in the springtime. Many of these little creatures are present during winter but are lethargic and still because of the cold. Others are born in the springtime. Only when it is warm enough, as it is here in April, do the flying insects (the only food of all species of swallow) reach the upper parts of the atmosphere where the Swifts usually fly. Only then will the Swifts appear. The reason, therefore, why they appear earlier or later, is related to whether the country they want to inhabit is nearer or not to the warm southern regions.

As they come back to us, Swifts take possession of the same nesting places which they occupied the year before. I observed this in the case of a hole in a tower in Pavia, not high off the ground, where each year two Swifts nested. I caught them when they had chicks and marked both of them attaching crimson threads to their feet and the next year I had the pleasure of being able to notice that mark on one of the pair. I assume that the loss of its partner was due to death rather than infidelity.

Holes and crevices in walls, cornices and tiled roofs, are the natural sites in which these birds nest here. But there are also artificial sites prepared with a kind of artistry for this purpose. In many dovecotes in Lombardy and in the hills nearby, there are, as well as a few big holes suitable for pigeons, rows of many little holes, sometimes double, one row above the other, extending inside the wall of the dovecote where they enlarge into a kind of cell. This cell opens into the dovecote but is normally closed by a brick or a wooden plug. By staying inside the dovecote or using a long ladder, one can examine these cells. Swifts were using a lot of them, nesting inside. Thanks to these cells, I had the opportunity to make a series of observations, which would not have been easy to do otherwise. I will recount how, thanks to them, I discovered that nesting Swifts behave in the same way as House Martins. If we take out the old nest, they will make a new one but if we leave the nest, they will use it for more years. I have observed many of these nests and the nature and texture seems unique to me. I will describe one. It had an elongated concavity of which the major diameter measured 4 inches, and the minor one 3½ inches. It weighed 342 grains. The exterior was made from the faeces of the Swifts and contained undigested parts of insects, such as the remains of legs, heads, membranous wings and so on. The inner portion of the nest was the same except that here the droppings were combined with several specks and flakes, and these tiny things could be seen even though they were in the cavity and partially covered by feathers and that sort of down which poplar trees produce in the spring. But these materials would not stay together by themselves to form a consistent body like a nest. Therefore, a substance was needed to bind them and, so to speak, paste them and this substance is administered by the Swift itself, and it is a slimy fluid, always present around its jaws and throat, and which serves for coating the insects it takes. On breaking up and carefully examining one such nest, I observed that it was permeated almost throughout by this sticky mucus which is already hard and shiny, and is the same ashy colour as when it is inside the cavity of the mouth. Adhesion of the objects described above is possible with this substance and the nest can then be compressed and shrunk without breaking, having acquired a degree of elasticity whereby it resumes its original form after compression.

If a Swift wants to build a nest, the droppings which it has deposited inside the hole are to hand and physically perfect for this use. Down from the poplar trees, which is abundant in the spring, is taken from the air and more than once I have seen a Swift rush in and take it away. I have also seen them do this with feathers flying through the air. Indeed, I have made similar comments about martins, and I recounted in the previous monograph how I was given the opportunity to hunt them with a stick and a feather which they grabbed with their bill; I have also done this with Swifts but with a less successful outcome.

The Swift does not always fall to the ground despite the attack leaving its body entangled with the stick, because of the robustness and the strength of its wings, and so it is able to win throughout. There is a curious way of making Swifts come close which is useless with Swallows. It is to wave a handkerchief out of a window not far from the flying Swifts. The trick can work even better by waving a handkerchief attached to the end of a pole. Swifts then fly, impetuously, straight to it, approaching it so closely and when almost right upon it, rush past it, or change direction, bending to the side. They soon return to the handkerchief, however, then dive away again, continuously going to and fro, and by this artifice, one can draw them over and kill them with a shotgun; this was the custom amongst hunters, who would also throw up a hat a number of times with equal success. I do not know why these birds throw themselves at such things, unless it results from a natural habit of pouncing on living things in the air which are their prey, or perhaps, they actually suppose these things to be some harmful bird of prey, having seen how fiercely they will mob hawks if by chance they happen to come near their dwellings. If I released some feathers into the air from a tower or eminent window at a time before the chicks had hatched, the Swifts would come close and take them to their nest, but at other times they had no interest because they had no use for them; this has also been observed in House Martins. Moreover, in the old days they did hunt Swifts in other countries in a similar way to mine. Bellonio[30] says that on the island of Zante[31] children caught a great abundance of them thanks to a feather in which a hook was hidden attached to a wire that hung from a stick. The Swift was hooked in by its desire to take the feather to its nest. When I sailed for Constantinople[32] in 1785, I landed on that island on the 24th of September when the Swifts had already gone but I heard that this way of hunting had not entirely been abandoned. We know from how the same Author in his time they caught them on Candia[33]. They bent a little needle into a hook and, after sticking a cicada on it, they then tied this to a long wire held by an islander. The winged insect flying through the air was then taken by the Swift and, once hooked, the wire was pulled in by the hunter. This latter game originated from observing the Swifts trying to catch cicadas, not, I believe, to use these insects in the construction of their nests but as food, bearing in mind that they leave the ground during the hot season when the birds have finished breeding.

I have given above a description of one of their nests, which suffices to give an idea of them all, as this kind of work is unique to them. Swifts are less involved in the construction of their nests than Sparrows. So Swifts will often

[30] Bellonio: Pierre Belon du Mans (1517-1564), "*L'Histoire de la Nature des Oiseaux*" (1555), Paris.
[31] Zante, also known as Zakynthos, is a Greek island of the Ionian Sea.
[32] Constantinople: now Istanbul, Turkey.
[33] Candia: the island of Crete, Greece.

seize their nests, either because the Sparrows have already used the nesting sites before the Swifts' arrival, or, perhaps, to save them the trouble of making one specially. I have seen some of these Sparrow nests, which have been adapted by Swifts for their own use. The materials are thread and flax, little bundles of wool and hemp, fragments of hay and straw, and many feathers. Only the interior surface is completely covered by the gluten of the Swift mentioned above which forms a tough, elastic, ashy-coloured and diaphanous coating, under which can be seen the matter already described. And all the evidence is that the *pulli* inside these nests belong to Swifts not to Sparrows.

Just about all the authors who have written about Swifts tell us that they like to nest up high. Indeed Pavia records many towers which are extremely rich in these birds, and where, in the breeding season, they are never seen dwelling in the lower parts but only in the middle and the top, hidden in the holes that were once used for scaffolding. I have made similar observations elsewhere. Nevertheless, it is far from being their general practice. There is evidence from the busy bridge over the River Ticino in that same city, where many Swifts nest under the arches (even though they are next to the feet of passers-by and not far from the water). In a similar vein, it has been pointed out that Swifts will inhabit the lower parts of towers and dovecotes just as much as the higher ones; moreover, it is often the lower building which shelters a larger number of these birds, while another, much higher one shelters fewer or none, even though the same holes exist in both and they are in the same city, village or castle.

I have noticed that Swifts' favourite places are buildings in hilly or mountainous regions, surrounded by wide open spaces, with no prominent trees, and where accordingly they can rush around flying acrobatically. It is the same with buildings located on rivers with running water. For this reason, dovecotes in both these kinds of sites are usually occupied more abundantly than others, whatever the nature of the skyscape, and the Swifts nest in both of them equally well.

It was thought that because they do not land on the ground[34] or in trees, that Swifts mate in the holes where they have their nests. It was very helpful to be able to clarify the facts through having the opportunity to utilise a 'Swift dovecote', which is what I will call those towers designed to house these birds. When Swifts return to us, they are almost always in pairs; they are, therefore, both often in the same hole at certain times of the day and before nightfall. Therefore, as not to scare them, I watched them through a thin hole in the little

[34] «*Swifts sometimes rise over heaps of manure, where they get insects and where they take flight*» (in Montbeillard, *Le Martinet Noir*). I would like to add that an old hunter told me that one day he saw a Swift or something similar, which flew into a mass of soft mud at the edge of a river bank where there were many House Martins taking soil to make their nests. But these are extremely rare incidents and do not change the fact that this kind of bird does not land on the ground.

wooden door expressly made for the purpose of blocking the nesting cell. I then saw the male mating with the female many times, just as the swallows do, except that the act in Swifts is of shorter duration. The male, at those sweet moments, emitted a very small repeated cry, which should not be confused with the longer and infinitely higher cry which sometimes characterises Swifts inside the nest and which is also heard outdoors at night time.

After they have entered their holes and during mating, when they are hatching eggs or feeding *pulli*, Swifts are so inept and unaware, that not only do they not flee at the appearance of man, as I have seen Sparrows do the moment I opened the door of the little cells where they had their nests, but they do not even move away. I should also say that I could remove the female from the eggs, handle her and put her back on them, without her seeking to leave; at most she would go into a corner of the little chamber and remain there, still. The same inertia applied to the male when entering the hole to feed the *pulli* or a hatching female. Often I had to place the bird at the hole from which they had entered and almost give it the impetus to fly away. But I think this inertia is due less to a lack of that instinct by which every animal ensures its own preservation by escaping from danger, and rather more to their long wings and very short feet which makes it hard for them to lift themselves from any flat surface on which they are resting.

The behaviour of Terns, which live mostly on the sea, and in particular the ones we call *stolida*, supports my explanation because they will let men take them without any attempt to escape and they also have very long wings and are extremely slow at taking flight.

The Swifts' apparent indifference to escape when they are inside their nests disappears, however, when they are outside the nest. In the first case, they only move a little, or not at all because they know that the extremely narrow space prevents them from opening their wings to enable them to rise from the surface. It is not the same when they are placed on the floor of a well-lit room of equal length and width. I have seen them take flight even though it may be very flat and they have no high place on which to climb, contrary to what Linnaeus and others have said: *in terram decidentes non avolant* (Syst. Nat. *Hirundo apus*). When, therefore, an already mature Swift is lifted from the nest and placed on flat ground, it almost immediately points its feet on the ground lifting itself up a little, and at the same moment opening its wings and, fluttering, it lifts away from the ground, in a brief and low wheel-like motion, then once again in a less narrow and higher motion, then a third movement of greater extent and, gaining height, becoming a free lord of the air. I have tested ten individuals, including juveniles and adults, in a room, two of whom I let fly out of a window. I agree, however, that if they are grounded by chance, or land on ground full of bushes, high grass or other similar barriers, which appear

to them like insurmountable rocks, then they are unable to flutter their wings.

Usually the brood of a Swallow is two, three for a House Martin, and only one for a Swift. They will breed a second time only if the first brood has perished because cold weather in May killed the *pulli*, either when they were still inside the egg or when newly hatched. Ordinarily, there are no fewer than two and no more than four eggs. The female is the only one to undergo hatching, and during hatching she is fed by the male which, four or five times a day, vomits into her mouth a mouthful of flying insects, such as winged ants, flies of several generations, little bugs, small butterflies, etc. A curious phenomenon can be observed in the males towards evening which I have studied many times with delight. Just before sunset and having performed a series of turns and twists round the towers, dovecotes and other buildings where they have their nests, all the time screaming very sharply, they then rise little by little to a greater height than normal while continuing to make their shrill calls and, dividing into little flocks of 15, 20 or more, they lift up ever higher until finally they are out of sight. Such a phenomenon occurs consistently every evening, about twenty minutes after the sun drops below the horizon. On looking for the direction they took before they disappeared, I would see that they had left the town towards the countryside. So, while a quarter of an hour before they disappeared the air was filled with their cries, once they had gone, nothing could be heard except the broken voice of a female inside a nest.

On observing that the same number of Swifts was flying in the air at sunrise as before sunset, I assumed that the same Swifts had come back but did not know if their return had happened at night or at the break of day. To get to the truth, I went to the top of one of the highest buildings in Pavia an hour and a half before dawn. The sun rose over the horizon without the appearance of a single Swift. They started appearing 12 minutes after sunrise and after 23 minutes they were as numerous as usual. This is what happened. At first, I could hear the cries of the Swifts but could not see even one, then they began to appear very high up as black specks against the sky. Then, diving down, they reached the towers of Pavia in an instant, and began again their cries and usual flights through the air. They do not descend in the same way that they ascend, that is in small flocks, but divide, and only come back together into groups around their homes.

After having hatched the eggs, the female also incubates the new-born Swifts during the early days in the same way as other birds do, because the heat of our climate is not strong enough to furnish the energy which the *pulli* need. The newly hatched Swifts, unlike those of other swallows, are almost mute and ask for nothing but, fortunately, their parents understand the call of nature and administer the food they need: they feed them two or three times a day. Montbeillard states the same.

I have to say candidly that I cannot agree with his statement even though it is expressed in very clear French, at least when I think of my own observations of Swifts. During the summer holiday of 1789 in Fanano, I slept in the room of a tower inside where a Swift nested each year in a specially-made hole in a wall. The hole continued into my room and the inside part was closed off but could be opened by means of a moveable brick. When I got there, the eggs were not yet hatched but a few days later two chicks were born. I then saw that every time the parents entered the hole and approached the chicks (my presence did not scare them at all), they opened their mouths to receive the food, and at the same time they made a weak cry which continued for some time. They did the same with me when I touched the tip of their beak with my finger. At this time, they had no feathers. Feeding times for House Martins and Swallows are not frequent, maybe four, five, or six times a day. I made similar observations in more than one Swift dovecote in relation to the feeding call, which is universal to all nesting birds and to the number of feeding times each day. When the older chicks no longer need to be warmed by their mothers, they also disappear after sunset with the males, and we lose sight of them high in the sky, only to see them return at sunrise. And these comings and goings continue as long as the Swifts inhabit our houses.

Montbeillard talks about it too but as a phenomenon that is observed only in July when the departure of these birds is imminent, which does not at all fit with the observations which I have narrated above. He is convinced that they spend the night in the woods hunting for insects but I doubt whether they can see sufficiently to prey on them. My doubts are based on evidence. I related before that when Swifts are put on the floor of a room, they will lift off the ground and fly, making continuous circular flights around the room. I have observed that it is then difficult to catch them because they wheel towards the upper part of the room. But there is a very easy way to catch them straight off and that is to darken the room immediately by closing the windows. They then suddenly lose direction of flight, bang against the wall and fall to the ground. For this to happen it is not necessary for there to be a complete loss of light. Incidentally, I have noted the same phenomenon with the Barn Swallow, Sand Martin and House Martin. Despite this, I would not assert that Swifts cannot see at all during the night time unless the stars are shining in the sky, otherwise they would be dependent on the stars to fly. I would state only that it seems to me their eyes are unfit to see very tiny living things in the air at night time. And my assertion gains strength from the following observation. While I was on a hill in the early morning at the time when the Swifts were descending and returning to their homes, I managed to kill two with a shotgun. Their gizzards were empty, except for a residue of insects which were unrecognisable because of the effects of digestion. It was therefore clear to me that they had had no

food during the night otherwise there would be an amount there, and that the residue was probably prey from the day before.

Anyone who knows even a little of the behaviour and habits of Swifts, will recognise how their flight resembles nothing more than a game when they are exercising their wings or concentrating on catching food. In the first case, they move through the air in continuous curves, twisting and turning around bell towers, dovecotes or Swift towers, their flight paths marking directions as though they were following actual roads, and always flying strongly and in flocks, and always emitting high-pitched cries. In the second case, their flight is slower, often without any fluttering of the wings, but it can be interrupted by a sudden flying away in any direction and is undertaken by lone and silent Swifts. We observe precisely this second way of flying in Swifts when they return to us not long after sunrise, and hunters too know this well and choose this time, when the flight is more controlled and slower, so as to be able to kill them more easily. I think the reason why they disappear at dusk and fly so high (something which is not observed in Swallows), is because they find the temperature up there cooler than lower down; it is as though these birds love the warm but avoid it when it is too great, as we will see later on. It is remarkable how long it takes young Swifts to leave the nest and fly. They take at least a month, when nearly half that time is enough for a young Sparrow or Goldfinch or even birds larger than Swifts, such as Common Starlings. This law of nature applies also to other swallows but to different degrees. The Barn Swallow starts to fly earlier than the House Martin, even though the latter could fly like a Swallow at this stage but it does not yet dare to leave the nest. The Swift needs more time than both to exercise its wings. This seems to be the reason for the following disparities. The Barn Swallow could be called the "daughter of the air" because, while employing most of its time in this vital medium, it also uses more perching places than the House Martin; sometimes perching on the roads, frequently in trees, and most often sitting on the iron bars stretched horizontally across the rooms and under the arcades where it pastes its nests. The first time that new Swallows leave the nest, they are brought back by their parents after a short flight because they cannot sustain a longer flight as their feathers have not fully developed and, consequently, we often see them resting on some support or another. The slow flying and the continued feeding by the father and mother for some time, is additional evidence of their immaturity. In contrast, the House Martin flies at the same speed as its parents on the first occasion of leaving the nest, as we recorded in our previous monograph, and they need to be able to because their instinct is to remain in the air longer than the Barn Swallow. For Swifts, this need is far greater because they have to in the air even longer.

Therefore, they leave the nests where they were born much later and by

then, the development of their feathers is such that there is no appreciable difference between the length of the wing of a mature fledgling Swift and that of an adult. Nor could I find any difference in the speed of flight between the two; and if you put a young Swift on the flat ground, it is as able to fly off just as an adult does.

This natural instinct in these birds, which are rightly called the "children of the air", not to leave the nest until safely able to sustain flight, is not found in terrestrial birds. The Magpie, Jay, Starling, Blackbird, Woodpeckers, Tits, Sparrows, and hundreds of other of our countryside birds, leave the place where they were born, or rather they are encouraged to abandon it by their parents, when they can withstand short flights which enable them to move from tree to tree without falling. Other, even more terrestrial birds, such as the Quail, Partridge and Rock Partridge, leave the nest before they are even able to fly. It is the same for many kinds of water birds. Nature is always watchful for the conservation of species and so it provides for the safety of these two kinds of creatures as it does for the swallows.

The structure of a Sparrow, Blackbird, Tit, etc., or Nightingale is such that, besides being able to use the secure support of trees, they can also land without danger of stumbling and can, in any case, counteract this by flying away. Furthermore, a Quail, Rock Partridge or Partridge, even while still unfit to take to the wing, can escape on foot and by strategically hiding in grass, bushes and other hidden places, evading the insidious searches of vermin, and often even those of "Nature's Tyrant". Water birds, if pursued by hunters or other enemies, can find safety in similar hiding places and remain free, even though they are not expert flyers. Swifts, unable to land in trees, are almost sure of meeting death if grounded, have no other place for escape or sanctuary than the open and endless air, and so they never leave the nest unless they are sure of being able to remain suspended in this invisible medium.

In Lombardy, young Swifts are mature by 24th to 30th of June roughly, unless cold rains precede and delay maturity. If the cold deepens to an extent that the eggs go bad or the new-born chicks are killed, then a new brood is brought forth in August, and I have found chicks in the nest in the middle of that month. But this rarely happens, and the date at which the maximum number of newly observed chicks is ready to fly is, as I have said, around the last six days of June. Shortly before then the Swifts form mobs around the places where they hide their beloved broods; they are never as numerous as at this time. However, this mobbing does not take place just at any time of the day. Fearing the heat, they burrow into the holes where they have their broods during the sultriest hours of summer. It is at about 10.30 in the morning that they begin to thin out and by noon they are almost all gone and do not reappear until around 5 in the evening. Therefore, on these hottest days, it is worth taking a look at any bell

tower, tower or dovecote where they nest as, with the increase of heat, they begin to enter the holes and cracks of these buildings in that way of theirs which is so quick, almost touching the walls with their outstretched wings, then, in the blink of an eye, closing them and penetrating into the holes, disappearing inside. And they stay inside until after noon when, with the declining heat, we can observe them coming out from the same holes, with that curious practice of falling by about two feet with their wings half-open, then suddenly puffing out and flying as if swimming in the air. Swift dovecotes are proof that these birds hide away in the hottest hours of the day in their cramped hovels, after which you can always find them inside; nor is this fact ignored by those who go into the towers in search of Swifts for sale because they prefer this time of day for catching the chicks and older ones.

Montbeillard made a remarkable discovery, House Martin chicks weigh more than their father and mother. It was even more remarkable that I was able to make the same observation in Swifts. I wanted to examine the proportions or, as I should more rightly say, the disproportions in the weights between Swifts and other birds because it seemed to me this aspect of comparative physiology deserved the reflection of a Naturalist.

On the 26th of June, I was brought a nest of Swifts with two chicks as well as their father and mother. The father weighed 38.5 *denari*[35] + 6 *grani*. The mother weighed 39 *denari* + 5 *grani*. The weight of one of the chicks stood at 48½ *denari* + 9 *grani*: that of the other one stood at 50 *denari* + 9 *grani*. The feathers of the two chicks were just beginning to emerge from the skin. On the same day a second nest was brought to me with a chick and one of its parents; I found that the first weighed 56 *denari* + 11 *grani*, and the second 37 + 10 *grani*. The chick's feathers were about one quarter developed. Another time I had a nest with one parent and four chicks at different stages of maturity. The least mature of all, which was almost naked, weighed 43 *denari* + 2 *grani*: the second one, in which the tips of the feathers were breaking the skin, 45 *denari* + 7 *grani*: the third one, whose feathers had not yet reached the final quarter of their development, 53 *denari* + 1½ *grani*: the fourth, the most mature of them all, weighed 39 *denari* + 11 *grani*. The mother of the four chicks weighed 39 *denari* + 11 *grani*.

These facts form the most convincing evidence that the weight of young Swifts is considerably greater than that of older ones. This preponderance results primarily from the fat which covers the whole body and I must point

[35] *Denaro* (pl. *denari*); in the areas where Spallanzani was born and lived (Duchy of Modena, Duchy of Parma, Duchy of Milan) a *denaro* was worth 24 *grani,* 24 *denari* worth 1 *oncia,* and 12 *once* worth 1 *libbra.* The weight of a *libbra* varied from duchy to duchy and in the same duchy from town to town: in Modena the *libbra* was 0.3404 kg, in Reggio 0.3245 kg, in Parma 0.3280 kg, meanwhile in the Duchy of Milan (Pavia), which was ruled by Austria, the *libbra* was used only for pharmaceuticals and weighed 0.42001 kg.

out, also penetrates the interior, but from which the latter are completely free. This fat is of such taste and delicacy, like the flesh that lies beneath it, as to make the chicks a delicious meal, while already mature birds are unappetising to the palate, fibrous and tough. However, I must point out one characteristic relating to the fatness of the chicks that, in a true sense, came as a surprise to me. The chicks I referred to above had not reached maturity since they were nearly naked, some having feathers just beginning to pierce the body and others with little sign of development. Following these observations, I obtained some more mature Swifts and found that the weight diminished rather than growing or remained the same. Moreover, I knew that having reached this stage of maturity, the bird would lose even more weight, as in those who have already become skilled flyers. The considerable loss of weight in these already fully developed chicks does not result from the leanness of the meat but from the disappearance of the fat which means that to the eye older Swifts can be confused with young ones.

So, at two different stages in the development of the same bird, one has two apparently paradoxical findings, on the one hand the weight of the chick is at its greatest, and greater than that of its father, at an age when one would expect it to be lower, and, in contrast, the weight decreases at that stage when its maturity suggests it should be greater.

But is this bird species with which we are now preoccupied the only one in which this apparent double paradox is seen? We have already said that this was first discovered by Montbeillard in House Martins. Five chicks with no down at all weighed 3 *once* 12 which is the equivalent of 345 *grani* for each one, whereas the father and the mother weighed 288 *grani*. I have also made similar observations in both young and old House Martins. In one case, the weight of the father stood at 12 *denari* + 11.5 *grani*. That of the mother at 15 *denari* + 17 *grani*. They were both taken from a nest within which there were four chicks, two nearly naked, a third in which the feathers had begun to appear, and the fourth lightly feathered. The weight increase reflected greater development. The two nearly naked ones were of equal weight which was 17 *denari*. The weight of the middle one was 16 *denari* + 18 *grani*, and the fourth was 19 *denari* + 7 *grani*. Therefore, those among the House Martin chicks who were furthest from maturity and without any downy feathers were heavier than the adult ones. In addition, one should not omit the fact that the surplus weight in the young ones was the result of fatness, of which almost all the adult birds were free. And, as in the Swifts so in the House Martins, this same fatness reduces as they grow more mature. Whenever, therefore, these birds are nearly ready to fly, the weight is usually below 19 *denari*, and when they fly from the nest it equals or slightly exceeds the weight of their parents, as I have learnt through very many experiences, which I do not refer to so as not to bore the reader excessively.

An essay about two broods of Barn Swallows told me the same thing. There were five chicks in one brood and four in the other. The first-born were so covered in feathers that they could fly, and the others were partially naked. These latter, then, weighed more than the former, and the father and mother Swallows weighed a few *grani* less than the weight of the more mature chicks, one of them reaching 12½ *denari*, another 12, another 11¾, when one of the more mature chicks weighed 12¾ *denari*, another 12 *denari* + 19 *grani*. But the weight of one of the less mature chicks amounted to 14 *denari* and 3 *grani*, and another to 14 *denari* and 9 *grani*.

The same thing occurs with the Sand Martin and I shall discuss this in the next monograph. Travelling in 1780 along the River Po[36] from Pavia to Guastalla[37], my boat stopped twice under a high bank riddled, so to speak, with holes made by this species of swallow, large numbers of which came in and out of the holes and I was able to do lots of hunting, extracting the chicks from the holes with a thin rod with a grappling hook at the end. It was around 7th July, the time when the chicks are either already mature or are becoming so, and we know very well how delicious to our palates these little birds are at this time. Some of them were able to fly, others were beginning to get their feathers and others were between the two. I cannot give the weight of these Swallows, since I did not think to do such experiments at the time. However, I will say, without fear of error, that the largest and fattest were the immature chicks, and that the fathers and mothers (having got some of them out of the holes) were not at all fat, and the thinnest individuals were those closest to fledging. And it is worth noting that the preponderance of weight in the chicks of the above mentioned four species of swallows does not result from their greater flesh condition but for the most part from fat which more or less coats their bodies, and in Swifts this fat spreads everywhere and is so thick as to make them seem like little balls of butter. I say this part because the gizzards and intestines also contribute to the growth in the weight of these birds, being bulkier and heavier in their early development, as has already been noted by Montbeillard. It appears to be the case that this disproportion in weight in the early development stage results in part from the fathers and mothers depriving themselves of necessary food so as to give it to their chicks, as Montbeillard noted that the gizzards of these chicks are so widened from the food they contain as to resemble a cucurbit, meanwhile the gizzards of the father and mother shrink to the point that they contain almost nothing. He bases his explanation on two old House Martins with almost no food in their gizzards, whereas that of one of their chicks had a superabundance. I believe this case to be true but at the same time accidental

[36] River Po, the longest river of Italy (652 km), which crosses the north of the country from the western Alps to the gulf of Venice.

[37] Guastalla is a small town in the province of Reggio Emilia in the Po Plain, northern Italy.

and contradicted by innumerable others, because I opened very many old swallows of the four mentioned species during the time in which they fed their chicks so as to confirm the statements of this Frenchman, and I have always found their gizzards more or less filled with flies and other tiny animals which fly through the air in no less a quantity than that of the chicks which feed from them. What, then, can be the cause of the size of the girth of most swallows when they are immature, which is the same as when they become mature? I dare to take a wild guess at answering. Having at different times fed freshly hatched broods of House Martins and Swifts, giving them tiny and tender insects as food, I have observed that when they first begin to be covered with feathers, they are, so to speak, insatiable, nearly always demanding food with begging calls and swallowing it greedily. This insatiability fades in proportion to the development of the body, and almost ceases when they gain full development. There is no doubt that the surplus of food which these birds I refer to above, took from me at an early age, they would also have taken from their father and mother, likewise responsive to the natural instinct to satisfy a basic need. It therefore seems very natural that the fatness in these nestling birds must grow or decline as a result of the increase and then decrease of the food they consume[38].

As breeding usually ends in July, Swifts then disappear from our homes, and this disappearance happens gradually because the chicks leaving the nest do not behave in the same way as Barn Swallows and House Martins who repeatedly come back to stay in the nest for some time, but whenever the Swift chicks leave, they never come back again. If you want to pick up a brood of Barn Swallows or House Martins which have only left the nest a few times, just approach at night time, silently, and you will be sure to get them. But if you once let mature Swifts leave a dovecote [for Swifts; *NT*], there is no hope of seeing either young or old back that year.

This departure, however, is only from our homes not from our climate. Badly adapted to the scorching summer heat, they leave our plains as soon as they can take the young with them and move to the mountains in the Alps and Apennines, staying there until the cold comes. On my several trips into these mountains, and especially the Apennines which are more familiar than the Alps, I often ran into Swifts, which being a very sociable bird were always in groups, flying at low altitude and moving from one place to another, but I did not hear their familiar cries.

[38] I do not know if another observation about fatness in birds has already been made, that is that while many of them become fatter towards the beginning of autumn; this is considerably more pronounced in older rather than younger birds. Birds like the Golden Oriole, Nightingale, Turtle Dove, Garden Warbler, Wryneck, etc. are moderately fat in September if born that year but very fat if older. Those who study comparative physiology should consider this fact, well known to hunters but perhaps unknown to scholars.

This kind of swallow is, within the family of birds, the one with the fastest and most sustained flight which is due to the length and shape of its wings. The Kite is celebrated for the incredible sharpness and range of its sight and for its high-speed flight. It has been said that even though this bird of prey flies so high that we lose it from sight, it can still find the little lizards, field mice and birds from high above and choose the ones it wants to prey on (Buffon's *Oiseaux T.I.*). According to calculations which have been made, these birds can see at a distance of three miles. The Kite has been no less praised for its flying which has been called its natural condition, and for the extreme ease with which it can accelerate, stop, hover and make other changes with such facility and lightness, almost as if it were swimming rather than flying.

While some of these appreciative observations may be true, others are exaggerated, and the birds which are the subject of this Monograph are better, in my view, in respect of both sight and flight, than Kites. In the eleven months of my stay in Constantinople, I continuously had before my eyes a multitude of Kites belonging to the species which live and breed there, and could study them with great ease, and when I am able, I will write their story. Here I only caution that I never saw in them as those celebrated sharp-sighted masters in attacking their prey on which they descended, so to speak, from the clouds. Often, they rose above that huge city so high, it is true, they became invisible to the human eye, or were just a tiny speck in the sky. But it never, ever happened that they then swooped down upon the green lizards, other lizards and amphibians, even though I carefully tried to search for them. When they did fling themselves at them and took them, the distance in the air from them to their little prey was 300 or 350 feet at the most, estimated by sight. Kites' absence of the fear of man is because they are never bothered but left to engage in their hunting in the most densely inhabited places, and I was present more than once and so I could not have been deceived (…).

As Swifts feed on insects that fly in the air, tiny beings invisible to us from afar, we do not know from how far away they can take them. I do not know if Bellonio was correct in asserting that these birds can detect a fly from an eighth of a league[39]. I am now able to report what I saw so well which happened by pure chance. One year when I was on holiday at Ginevreto Oltrepò[40] in mid-September, I went one day to the nearby Montù Beccaria[41] and halfway along my path I observed tens of Swifts which, through their continuous flying round the same spot, indicated to me that they were hunting

[39] The league ("lega" in Italian) is the unit of length commonly used throughout ancient Europe. The distance it represented varied from country to country but corresponded in theory to the distance covered in an hour on foot or by horse, from 4 to 6 km.

[40] Ginevreto Oltrepò, nowadays Zenevredo, is a little municipality in the Province of Pavia, Lombardy.

[41] Montù Beccaria is a little municipality in the Province of Pavia, Lombardy.

for insects. I found that their prey were in fact winged ants coming out of the ground. Of the many anthills in the surrounding fields, there was one large one in the farmer's backyard consisting of a mound of crumbled earth from the centre of which some of these ants were coming out through a little hole, and then flying up and soon being taken by the Swifts. This little scene caught my attention but in order to contemplate it better I had to move away from the anthill a little because my presence was causing the birds some trepidation. I therefore decided to shut myself away in the farmer's house from where I could see everything clearly but without being seen by these flying hunters. When a winged ant rose ten or twelve feet from the ground, the Swift, which had been wandering through the air with no clear direction, would then quickly swoop towards it with its mouth open, grab it and then close its mouth making that delicate sound with its bill, just exactly like a swallow when catching a fly as prey. Often the Swift would just descend from above and then I had nothing but my eye with which to judge the distance from which the Swift could distinguish the ant. But sometimes there were a few rows of trees close to me at the point when it started its rush towards the ant, and then, having a fixed point with which to accurately measure the distance, I found it to be about 314 feet. It is therefore demonstrated that Swifts can see accurately to 314 feet an object with a diameter of five lines[42], as long as it is one of these flying ants; I do not know if Nature has given Kites the same precision and sharp eyesight.

A Swift's descent with the speed of an arrow from high in the sky, almost hugging the ground then suddenly taking the opposite direction with equal speed and climbing again up to the same height, then scuttling into their narrow holes, creeping along the walls of the towers, dovecotes and other buildings without touching them, all these are new arguments which admirably confirm the accuracy and clarity of their eyesight. And the repeated cries they emit which sound so amazing and clearly show that their chests do not pant during these ever so fast excursions.

Still regarding the subject of flight, my observations show that Swifts surpass Kites. It is true that the latter delights in living in the air, wandering forever restless, then hovering suspended without any significant fluttering.

But it is also clear that they do take a rest on trees from time to time during the day and certainly roost on them each night. In contrast, Swifts abandon their nests after breeding (which, as I said earlier, happens in the majority of cases before the end of June) and during July, August, September and a good portion of October, they live in the mountains way up in the air without ever pausing, and I remember having seen on 7th November 1779 a flock over the

[42] The "line" (*linea* in Italian and *ligne* in French) is an ancient unit used to measure length equivalent to 2.2558 mm.

city of Reggio, a phenomenon which I have seen only once but it was fortunate because it showed the unparalleled ease with which they can stay in the air for a very long period of time.

Linnaeus would have it that Swifts wintered in "temples" (*Hybernant in Templorum foraminibus l.c.*), and with the word *temple* he meant every high building in whose holes they breed. Klein, Heerkens, Herman, and some other naturalists, also thought the same but they are all wrong. Montbeillard visited the nests of these birds in mid-April, twelve to fifteen days before their appearance, and could not find a single one. From all the evidence, it is clearly proven that, by the arrival of winter, Swifts have already left our climate. The inaccuracy of the alternate view is confirmed by visits which I made, all of them without success, in the winter and early spring to nests in Swift dovecotes: nor did I leave out, once again, with no success, the towers in Pavia which are so important to these birds.

As with Swallows and House Martins so with Swifts, I do not think it is the cold which drives them from our climate but the lack of food and therefore the need to move to another place where they can find food at their leisure. My opinion is based on experiments in which I artificially created cold conditions. Six Swifts, fathers and mothers of broods, were placed in six glass tubes which were completely surrounded by ice crushed into tiny pieces. In a short time, as recorded by the thermometer, each one of the tubes touched freezing point, and I left the birds in that state for three hours and three quarters. Then, when touched by a little glass rod, they bestirred themselves and strove to ascend the internal walls of the tubes, but in vain. When extracted, they showed almost their initial liveliness. Placed on the floor of the room where I carried out the experiment, they began to run or rather to crawl in that way of theirs, keeping their wings more or less spread, swinging right and left and, in the middle of this movement, they rose from the ground and flew, seeking to flee without caution out of the closed windows.

This was followed by another more severe trial, in which the Swifts experienced cold created by a mixture of ice and sodium chloride, which I had also used on other swallows. This mixture grew colder by degree so that the Swifts passed from freezing to -10.5 degrees. As the cold grew, they showed evidence of suffering, often struggling and gasping, despite there being no restriction in the air supply within the tubes as they were constantly open to the exterior. After they had remained at the recorded -10.5 degrees for 35 minutes, I took the birds from the tubes and put them on the floor. They were alive, their eyes were open and there was some movement but they did not move from one place to another. They stayed in this depressed state, one for seven minutes, another for ten, others for more, then, reinvigorated, they tried to escape, at first dragging themselves across the floor and then

flying towards the closed door. But I was not yet satisfied. I submitted them to an even more severe ordeal. For three hours more they remained inside the tubes at the same degree of cold, meanwhile I was looking through the opening in the tubes at their symptoms as they occurred. During the first hour, they struggled occasionally, during most of the second their movements were fewer and during the remaining period they stood, not lethargic and always keeping their eyes open, showing signs of life if you moved to touch them. Placed on the floor, and therefore once again exposed to the temperature of the atmosphere (the experiment was run on 27th June when the thermometer recorded 18¾ degrees above freezing), they continued still and, if supine, remained in that unnatural posture. But soon after, they tried to straighten up and succeeded; all of them, sooner or later, regained their previous strength. I noticed that while gradually regaining their strength, they drew out very long inhalations and exhalations.

While I was doing these experiments, I was preparing a new one with very cold temperatures. When the thermometer reached -13½, six Swifts were placed, as before, inside the tubes. One lived for only seven minutes, two lasted twenty-five, and the other for three, although they seemed dead after this period of time, they regained consciousness after an hour when they were transferred and kept at room temperature and this did not happen with the others; these three, however, finally deceased after a further eighteen minutes of the cold recorded above. This explains how this kind of swallow will die from severe cold even if it can tolerate it for longer periods of time, and that its nature does not therefore differ from that of the other two swallows. I believe, as I have said, that if Swifts leave our winter climate, they do so because of the lack of the insects on which they feed, and not because of the coming of the cold season. And so, the absence of these tiny creatures due to a sudden cold spell in the spring after the return of the Swifts to our neighbourhood drives them away from us for a few days – this implies that they can come back but later on it's fair to say that they do not come back so I am not sure if I have understood the sentence; and I saw this happen in a cold milder than that which drives away Barn Swallows and House Martins. This sometimes happens in mid-May, usually after a long downpour, which alters the temperature so that the thermometer drops from +12 or +15 degrees, to +8 or +7 degrees. This change in the air atmosphere does not cause the House Martins and Barn Swallows to leave their nests but it is not so for Swifts which all disappear and do not return with clear skies. It is not the rain which forces them to leave. To see how little they fear it, or more correctly, how they like the rain, you only have to observe them during a heavy rainfall in summer, flying high and numerous, with slow-beating wings, most of them not moving from the spot and showing clear

signs of joy, while other birds protect themselves from the heavy rainstorm in the cracks of buildings or under eaves, or amongst dense trees or in other suitable shelters. The reason that Swifts leave us is that the flying insects, which have been made torpid by the cold rainfall, cannot rise to the altitude where the Swifts fly but can only rise as high as where the House Martins and Barn Swallows usually fly.

Monograph no. 4 by Lazzaro Spallanzani

"The Sand Martin (*Riparia riparia* Linnaeus, 1758)"

The Sand Martin *Riparia riparia* (photo by A. Turri).

Abstract

i) Description of the Sand Martin; ii) Similarities and dissimilarities with the House Martin; iii) Its late arrival in springtime like the Swift; iv) The sand banks of watercourses are the sites where it digs to make its nest. How it avoids obstacles in the ground when digging and makes nests practically inaccessible to man. Examination of these holes and of the nests therein; v) Times for brooding. Possibility to send or receive news from far away in a very short time when the Sand Martin is hatching or feeding its fledglings, similarly to what has been described for the Barn Swallow and the House Martin; vi) Disappearance after completing reproduction; vii) Whether during the cold season it stays hidden in the holes dug for nesting; viii) On the disappearance of this bird, the explanations put forward by other scholars are examined together with the contrary opinion of the Author; ix) Specimens of Sand Martin subject to various degrees of artificially induced cold; x) Whether they hibernate in cold situations. Research extended to other kinds of swallows; xi) Our non-migrating birds feel the cold less than migrating ones; xii) An exceptional period during which many small stopover birds were observed; xiii) It is thought that the Sand Martin possesses some sort of ability or power that is awakened in certain periods of time, inducing the bird to change climate, independently of the temperature of the atmosphere and decrease of food sources.

Riassunto

Descrizione del Topino. Somiglianze, e dissomiglianze con il Balestruccio. Alla guisa del Rondone suo tardo arrivo da noi in tempo di primavera. Le rive sabbiose dei fiumi sono i siti che fora e dove costruisce il nido. Come sa difendere questi fori dalle protuberanze, e renderli poco accessibili agli uomini. Esame di questi fori e dei nidi collocati dentro. Tempi delle covate. Con il Topino che cova o che dà l'imbeccata ai piccoli si possono inviare o ricevere notizie da lontano in un tempo molto breve, come si è visto con la Rondine comune e il Balestruccio. Dopo avere nidificato scompare da noi. Se durante la stagione fredda stia nascosta nei fori fatti per riprodursi. Si esaminano le ragioni addotte da altri per questo occultamento e si riferiscono le ragioni contrarie dell'Autore. Topini sottoposti a diversi gradi di freddo artificiale. Se a causa del freddo vadano in letargo. Questa ricerca è estesa ad altre rondini congeneri. Gli uccelli stazionari presso di noi risentono meno del freddo degli uccelli di passo. Epoca memorabile, in cui sono stati osservati diversi uccelli migratori, dalla quale si deduce che in loro si occulti una facoltà o potenza che, risvegliata in certi tempi prefissati, li induce a cambiare clima, indipendentemente dalla temperatura dell'atmosfera e dalla diminuzione degli alimenti.

The Sand Martin was also named by Linnaeus and other zoologists as "Bank Martin" because of the places it frequents and makes its nests, literally the banks of watercourses and sometimes beaches. I had the opportunity to inspect several sites along both the R. Ticino and the R. Po as far as Goro[43] and where it flows into the Adriatic Sea, thanks to a boat made available for me. Thus, I was able to stop wherever I saw banks riddled with holes dug by these birds, and this was an extremely favourable condition to add new and reliable information to what had already been written about them.

The Sand Martin is the smallest among the swallows described in this series; the lower part of the body is whitish; a grey ring surrounds its neck and the same colour is found in the upper part of its body. Its legs are short like those of the other swallows. Its flight is faster than the House Martin's but is usually closer to the ground. When it lands, it is able to take off quickly. Its calls and shrieks resemble more those of the House Martin rather than those of the other swallows. Although the range of its sounds is rather limited, it can satisfy all its communication needs.

In our region the Sand Martin appears towards mid-April; therefore, later than the Barn Swallow and the House Martin, similar to the Swift. Like the other species of swallows, it can disappear for a few days owing to bad weather or lack of flying insects, which make up its only food source. The Sand Martin flies all the time over the rivers along which it digs holes, constantly coming and going without ever leaving the sites chosen for its nests. Although, not all rivers are suitable for this bird, only those like the Po or the Ticino that have steep sandy banks, easy to dig into.

[43] Goro is a fishing village in the Province of Ferrara on the River Po delta.

According to Linnaeus, its tunnels should have a winding path. I am not denying that sometimes they are like this, but usually they are straight or almost in a straight line. As I was able to observe, when the path of their tunnels is somehow winding, the cause of this is some stone or tree root hindering this swallow's digging and therefore causing a diversion from the straight line. It has been said that Sand Martins can occupy the holes dug by Bee-eaters (*Merops apiaster* Linnaeus, 1758) or Kingfishers (*Alcedo atthis* Linnaeus, 1758). I do not dare to doubt this fact, although from my direct observations and from those of the people who look for their broods (since the young are excellent to eat), the Sand Martins from the Ticino and Po dig their nests by themselves. But what do they use for digging? We might think their bill, a very useful tool for birds, used by many of them to build their nests, but in this case the analogy would be misleading. Therefore, only the digging bird itself can give the solution. This should not seem strange, since in most cases only accurate observations can reveal the actual animal behaviour.

By observing a sandy bluff with many holes towards the end of April, when Sand Martins return to our territory, it will be certainly possible to notice some of these birds scraping the soil in order to prepare their underground shelter. Indeed, this is performed using their claws, which are long and apt for this purpose. Moreover, their claws allow them to cling to the steepest slopes, which are the only places where they stand, since they never go on tree branches or roofs or even on the ground. Although the old burrows may be used for several years, at every spring the House Martins dig new ones, and this is certainly done by the birds born in the same colony the previous year.

Common people have a good opinion of these birds since it is believed that they can forecast rivers' high flows by opening new burrows at higher levels on the sand banks to anticipate the rise of water level. Nevertheless, this is only a presumed ability, like the one ascribed to the Barn Swallow, which would forecast rain when it flies very close to the ground (*dum volitat iuxta terram pluvias praesagit*[44]). I am writing this Monograph while I am on holiday in a beautiful villa in Lombardy and, by looking out of the window, I can see some 35-40 Barn Swallows flying low together over a meadow from morning till evening. I have been watching them flying like this for over twenty days and not a single drop of rain has fallen so far. I observed this behaviour many other times, concluding that this so-called skill of Barn Swallows is in fact false. Equally inappropriate is the belief that Sand Martins would forecast inundations, nonetheless these birds know how to protect their nests from these unfavourable events by placing them high on the banks, where high-water conditions hardly ever occur. Furthermore, they adopt the precaution of

[44] Translation: "When it flies close to the ground it forecasts rain" (cf. Linnaeus C., 1758 – *Riparia riparia*. In: "Systema Naturae").

nesting only where sand banks are steep, as if they knew that nests dug onto gentle slopes would be easily accessible to humans.

The tunnels dug by Sand Martins are around11-18 inches[45] deep and their width is proportionate to the diameter of the hole opened by the birds. In both Sand Martin and House Martin nests, the entrance hole is slightly larger than the diameter of their bodies. This is true for many other species of birds. Indeed, a similar behaviour is typical of the European Bee-eater (*Merops apiaster* Linnaeus, 1758) and the Common Kingfisher (*Alcedo atthis* Linnaeus, 1758), which dig their nests on sand banks. Similarly, the Green Woodpecker (*Picus viridis* Linnaeus, 1758) drills holes in tree trunks by means of its sharp and very hard bill, opening a hole just sufficient to pass through it. In addition, the skill of the Eurasian Nuthatch (*Sitta europaea* Linnaeus, 1758) is also worth mentioning since it nests inside trees, although using pre-existing cavities. If the hole is too big, the Nuthatch will make it smaller by spreading mud and dung around it in order to reduce it to a suitable size for its body.

The Sand Martin builds its nest at the bottom of the tunnel in the shape of a rough segment of a concave sphere, padded with intertwined little roots arranged in a circle, the larger ones towards the outside and the thinner ones in the innermost part, with the addition of some little feathers. Here the female hatches five or six white eggs, similar in shape to hen eggs, wide at one extremity and pointed at the other.

Montbeillard, who does not seem to have ever observed this species, wrote briefly about it copying from other Authors and quoting Frisch[46], saying that Sand Martins produce just one single hatch. I cannot say what happens elsewhere, but I verified that along the rivers Ticino and Po there are always two and sometimes three hatches of the Sand Martin: the first one around the 8th of June and the last one in the month of August. During hatching time, Sand Martins do not go far from their nesting sites. By sailing down the Po, I could watch them as they flew fast up and down close to the water surface then, at a certain distance, they flew back and so on. Nevertheless, they always remained near their colony, often going in and out of their holes. Obviously, their constant flying over the water surface is meant for catching the little insects.

At a quarter of a mile from Pavia to the West, there is a canal with nearly stagnant water flowing between two sandy bluffs that are all riddled with the holes of these swallows. One day, as I watched their comings and goings over the water when they had their fledglings in the nests, I thought of the Barn

[45] The inch ranged in Europe from 2.60 to 2.708 cm. The metric system was adopted in 1798-99 under Napoleonic rule. Up to then, measurement units varied from country to country and also within each of them.

[46] Johann Leonhard Frisch (1666-1743), German Lutheran pastor and philologist, was the author of a famous and richly illustrated ornithological treatise.

Swallow which, when transported many miles away, quickly returns to the nest in which it had been caught (see Monograph no. 1). Therefore, I decided to do the same experiment with Sand Martins, exploiting the moment when both parents were inside the burrow to feed their brood. I had them taken out of the nest by means of a stick with a curved extremity. This took place one morning when I was leaving for Milan, taking the two Sand Martins with me. When I reached this town, I let them free at a prefixed hour. Immediately these birds flew high in the sky and soon they were out of sight. Each of them had a thick silk thread tied to one foot. I had an agreement with a friend of mine who knew at which time I would free the birds and would wait by the canal where the Sand Martins had their nest to check whether they would go back to their hole. As my friend duly told me when I came back from Milan, the birds had arrived at their nest after about 13 minutes from the time when I had freed them. In order to guarantee the accuracy of the measurement, we synchronised our watches. Once I returned to Pavia, after 4 days, I was able to verify that the birds were actually those that I had set free in Milan, seeing as they were still wearing the silk threads. Furthermore, since tying those silk threads to their legs, I was also able to verify that Sand Martins reuse the burrows dug in the previous year.

Once they are done caring for their broods, Sand Martins disappear from our territory until the following springtime. Their departure precedes the one of other swallows. Some years ago, towards the end of August, I sailed along the Po from Pavia to Gualtieri[47], in the Duchy of Modena, and another year I went down the same river from Borgoforte[48] as far as Goro, where the Po flows into the sea by means of several channels. These journeys along the river offered me the opportunity to see long stretches of the banks full of holes, although Sand Martins were no longer present. On the contrary, Barn Swallows and House Martins were still flying around in great numbers.

Some scholars believe that during the cold season Sand Martins take cover inside their burrows and that Barn Swallows might do likewise, thus confusing the two species. Montbeillard supports the idea that Sand Martins withstand the cold better than other swallows because of them frequenting rivers and streams and their blood would be less warm. In addition, the burrows they dig for nesting may look like those of hibernating animals. Finally, according to this view, Sand Martins would find insects in the soil to feed upon in every season (*l. c.*)[49]. Based on these remarks, this Author believes that, among European swallows, Sand Martins have the ability of hibernating underground, although this behaviour would be limited to some individuals only and certainly not to the whole species. (…)

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[47] Gualtieri is a town in the Province of Reggio Emilia.
[48] Borgoforte is a village in the Province of Mantua.
[49] Here redirecting to Montbeillard in Buffon & Montbeillard, 1770-1783, VI.

At this point, a remark by John Achard[50] should be quoted. Late in March 1761, this Author was descending the river Rhine on his way to Rotterdam and when he reached Basel, where the southern bank of the river is high and steep, he stopped to observe some boys who were lowering each other down along the sheer bluffs by means of ropes. These boys were using long sticks equipped with a wad-extractor[51] in order to pull out the Sand Martins from the holes, in which according to the boatmen, the birds stayed hidden until the warm season. He bought some of these birds from the boys and found out that they were numb, as if they were dead. Therefore, he placed one of these martins inside his shirt up against his skin and the other one on a bench in the sun. The first bird woke up after about a quarter of an hour whereas the second one did not regain its strength. Mr Achard, then, feeling that the bird under his shirt was moving, held it in his hands for a while and then placed it again inside his shirt for another quarter of an hour and, at this point, the Sand Martin became lively enough to fly off and disappear from sight.

As should any researcher searching for the truth, I shall now comment scientifically Montbeillard's thoughts as well as Achard's remarks, and then I shall talk about my own experience on this subject. Now, although because of evaporation wet areas are colder than dry ones, I would like to point out that in Lombardy Sand Martins start occupying their holes from mid-April, when according to my measurements along the rivers Ticino and Po the air is usually some degrees above +10°. Moreover, the idea that their blood should be less warm is groundless since at the contact with the thermometer and inside their body they result to be as warm as the other swallows. It is true that their tunnels might resemble those of some hibernating animals like marmots, although they are more similar to those of animals that do not hibernate in winter such as mice. Furthermore, the Hazel Dormouse, a hibernating rodent, never builds its nest underground. Finally, there is no evidence whatsoever that Sand Martins would find insects inside their tunnels both in winter and in summer. In both seasons, I had several tunnels dug out but at the most I found some cobwebs, caterpillars or lizards, and I could not say if our Sand Martins could eat these creatures since they are so different from the insects they catch in the air.

Achard left us a good description undoubtedly proving the existence of some species of swallows subject to lethargy but he did not specify which species. At the most, considering the circumstances, we may presume that he was referring to the Sand Martin. Therefore, we remain doubtful about it. Now I will speak frankly about the results my investigations led me to. In two

[50] John Achard (1721-1770) was a Swiss scholar who lived in England where he was tutor of Sir William Bentinck, 2nd Duke of Portland.

[51] The wad-extractor was a tool made up of two wound up sharp irons used to remove the wad from muzzle-loading firearms.

different seasons, that are October and February, I had 50 Sand Martin tunnels dug out on the shores of the Po. The digs, of varying depth, proceeded from the top of the bank; therefore, each tunnel was brought to light in all its length. Nevertheless, inside them there were only the old nests or just some remains of them at the bottom of the tunnels. In this way, I was able to demonstrate that this species of swallow spends the winter elsewhere, not in our regions.

These remarks coincide with the view of Mr Collison[52], who, in October 1757, did not find a single Sand Martin inside a bank riddled with holes in England, which had been dug in the most scrupulous manner.

Swifts, Barn Swallows and House Martins, which are usually considered intolerant to cold, were exposed artificially to low temperatures in order to determine up to which point they could resist. In particular, this experiment had to be carried out with Sand Martins, if what is said about some specimens in certain areas being found in winter, numb from the cold is true. Therefore, on 25th June, I placed four Sand Martins inside a large glass tube, placed in turn into the usual mixture of ice and salt. When the thermometer read freezing point, I checked the Sand Martins and noticed that they did not look at all weakened, and when I freed two of them, they started to fly in the room as well as before. By lowering the temperature furthermore, the birds started to struggle and tried to escape from the container, therefore showing some degree of suffering. The thermometer then reached -10° and remained steady: the Sand Martins were exposed to that temperature for 20 minutes. Afterwards, they were placed on a table, where they barely had the strength to move, stretching out their wings but with eyes completely shut.

Bit by bit they resuscitated and after half an hour they were flying in the room. Another half an hour of the same treatment was not sufficient to make them die. Indeed, once they were put on the table, they fell over to one side and remained still for some minutes, after which they started to try straightening themselves, although very slowly. After several useless attempts, in the end they managed to turn round and could walk on the floor, although without flying. By observing them carefully as they were coming to, I noticed that their breathing, which at first was imperceptible, slowly started to become heavier as their eyes were opening after which the birds regained mobility. Finally, after three hours after their removal from the glass tube, they showed enough strength to take flight, although they were not as lively as before.

At this point, I prepared another mixture of ice and salt and brought the temperature down to -14°; after 20 minutes, two of the four swallows were dead and the other two also looked dead, but after five hours they started to show signs of life, although they were so debilitated that they could no longer fly.

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[52] Peter Collinson (1693-1768) was an English naturalist. Here it is written "Collison" due to a misprint in the original text.

By comparing the effects of artificial exposure to the cold of Sand Martins with those recorded on Barn Swallows, House Martins and Swifts, we can say that all four species do not seem to feel the first exposure but at the second one (-8° or -9°) they definitely show signs of suffering although without dying. Only at temperatures of -13° or -14°, do they eventually die (see my other monographs).

I am truly surprised. I would have never believed that these small birds which arrive at the beginning of the warm season and leave when the cold approaches, together with many other birds, were strong enough to withstand such low temperatures. Indeed, we should admire these small birds because their reaction to an enforced shift from warm conditions to cold ones was certainly more sudden and harder than when they are progressively exposed to similar temperatures from autumn to winter.

But is this torpor that we observe in them a true lethargy, similar to that of many animals which, inaccurately, we say "sleep" during winter? It might seem so, if we consider the lack of movement, the extremely weak and hardly perceivable breathing and the state of unconsciousness, followed by their recovery with warmer conditions. Actually, these effects could be the result of a sort of asphyxia, comparable to the one experienced by these small creatures when they are kept for a short time underwater or inside a glass sphere with some mephitic gas. Such a situation is quite different from actual hibernation, which lasts several months and has no negative consequences whereas this artificial state of asphyxia has a lethal result after a shorter time.

Eager to understand this phenomenon if possible, I hypothesised that if some swallows really went into hibernation they would not be exposed to too low a temperature, such as a freezing temperature, or perhaps less strong, like the one experienced by the Barn Swallows of the Rhine observed by Achard. On four species of swallows, I first used snow or ice to lower the temperature but without causing torpor, but later I achieved much lower temperatures. Therefore, I thought that an icehouse[53] would be useful for my research. At this point, though, my sincerity and love for the truth compel me to admit that I made a mistake while I was reasoning about the lethargy of Barn Swallows.

In one of my notes to *Contemplation of Nature* by Charles Bonnet, which was translated and printed for the first time in Modena in 1770, I wrote that I saw some Barn Swallows die without becoming lethargic after I had kept them for 3 hours in a room contiguous to an icehouse, notwithstanding the thermometer read +5°. From this experience, I deduced that those swallows feel the cold, and in my Monographs of *Fisica Vegetabile*, published in 1776,

[53] In those days, wealthy families had a room in the basement (icehouse) in which they kept ice and pressed snow collected during the winter in order to preserve perishable foods and cool drinks for most of the year. It was also used as a remedy against fever.

I report the same observation reasoning about the causes of lethargy. After me, also Buffon came to the same conclusions by using an icehouse.

At this point, though, I have to rethink it, because although the fact described is true, otherwise I would not have published it, the consequence that I deduced is not true, *i.e.* that Barn Swallows generally cannot stand the cold.

Many years before I wrote about my tests in this book, I became aware of this wrong opinion during the sudden snowfalls that sometimes happen even in the spring, after the return of Sand Martins. In my first Monograph, I wrote that when these cold spells are short Barn Swallows do not go away and keep flying without showing any distress despite the harsh weather. Ten years ago (unfortunately I did not record the day and the year), at the beginning of April there was a heavy snowfall in Pavia which lasted several hours, with such low temperatures that the water along the roads froze. Moreover, in the countryside there was plenty of damage to the buds of fruit trees which were sprouting. Nearly all Barn Swallows and House Martins had already arrived and did not move away from the town, but since they could not find the flying insects, they fed upon they were looking for flies and spiders on the walls and in open barn houses. Then I realised that these small birds were not that intolerant when it came to low temperatures after all, unlike what I had previously thought up to that moment, since they were still active without suffering or damage, notwithstanding the snow and ice. Indeed, successive experiments with ice and salt proved that swallows could withstand much lower temperatures. During my experiments, I noticed that some birds went numb only after prolonged exposures to the cold. Therefore, I hypothesised that the same thing might occur to Barn Swallows when they are exposed to the same conditions. In order to demonstrate this, I needed the use of an icehouse. I tested four species of swallows by placing five individuals of each species into an icehouse during the month of May. In order to protect the birds from the considerable humidity of that place, I put them inside baskets covered with oilcloth, which in turn were buried in the snow.

In order to guarantee adequate airflow, I made holes in the snow in correspondence with the holes in the oilcloth. Now and then I checked them. After 12 hours, none of them had died; they instead remained awake and lively, staying very close to each other to protect themselves from the cold. I observed the same situation after another 12 hours, so I put two of them in my hands, after having tied a line to one of their legs, and set them free in the icehouse. The swallows started to fly around, although rather slowly. After 35 hours, four swallows were dead, precisely two Barn Swallows, one Sand Martin and one Swift. Prostration was evident in the other individuals: some were lying on the floor, others could hardly stand on their feet and, when placed on one hand they did not try to fly off. When thrown in the air, they fell to the ground with their wings half open.

These were the symptoms of impairment rather than lethargy since the birds did not keep their eyes shut, as it is always the case with lethargic animals; they looked ill and close to death. After 40 hours, another seven birds were dead and the remaining ones were dying. Even in these ones, it was not possible to recognise the symptom of lethargy but rather that of dying animals. Indeed, after 45 hours, none of them were alive.

Other tests were carried out in July with the same number of individuals of the same species and at the same conditions. I will not go into details since it is enough to report that after 48 hours in the icehouse, these twenty birds were all dead after showing the same symptoms.

I said that oilcloth was wrapped round the baskets to insulate the birds from the humidity of the icehouse. I soon realised that this was a necessary precaution after having seen that in another basket without this protection two Barn Swallows had died in just 2 hours and a half and I found them so wet as if they had plunged into water. Humidity was also the cause of death of the Barn Swallows after three hours from when they had been placed in the room next to the icehouse, about which I discuss in *Contemplazione della Natura*. I remember that when I got hold of them, I found them very moist.

Therefore, all these combinations using artificially induced cold seemed to rule out lethargy in Barn Swallows. Yet, I was still doubtful because of a large number of observations and experiments on warm- and cold-blooded animals that in winter hibernate; they will be the subject of another paper that I intend to publish. In fact, I had noticed that although they showed torpor at the approach of winter, they never became torpid in other seasons notwithstanding the exposure to cold weather, even at very low temperatures. I therefore deduced that if Barn Swallows or other similar species actually hibernated, the experiments so far carried out should be considered inconclusive.

Now, to clear these doubts it was necessary to carry out appropriate inspections at the most suitable time of the year, that is when Barn Swallows get ready to leave as the cold season approaches. This experiment excluded the Swifts which go away late in July and the Sand Martins which depart in September. On the contrary, Barn Swallows and House Martins leave later; therefore, they were ideal candidates. I made sure to obtain individuals of the two species as late as possible. By watching the habits of the House Martins which were under the eaves of some houses in large numbers, I noticed that after completing their last hatch they still spent every night in their nests, although every day their number dwindled and on 22nd September of that year only 8 or 10 were left.

At night-time, I had a few nests inspected. Four martins were caught but the others flew away. I also managed to catch Barn Swallows by waiting until 26th September, when five individuals were caught by means of a net in a reed bed

on which they had been sleeping for over a month. They were really among the last ones left since all the others had already departed.

These latest experiments, though, did not produce new information since I put the House Martins and the Barn Swallows in the icehouse immediately and none of these birds showed any sign of hibernation. Rather, they slowly perished getting weaker and weaker, as it had occurred in the previous experiments, until after 41 hours they were all dead.

In order for these experiments in the icehouse to provide adequate data, I wanted to be sure that the death of these birds was caused by the cold and not by the lack of food. I must therefore specify that whilst carrying out every experiment with the cold, a test was performed with some subjects of the same species that were kept in a cage without food in a room of my house until they died. Several individuals managed to survive up to the fifth day whereas the others resisted at least three and a half days. On the contrary, the birds placed inside the icehouse did not survive to the second day, dying at the most after 48 hours. It was therefore evident that in the icehouse death was determined by very low temperatures.

Furthermore, I observed the symptoms of Barn Swallows in the cages as they progressively failed, which were not the symptoms of animals turning torpid. Essentially, I noticed that they were not different from the symptoms shown by the Barn Swallows dying in the icehouse.

In short, I cannot think of more effective and clear proof to demonstrate that Barn Swallows, at least in our areas, should be excluded from the number of the species which hibernate during the cold season.

For what concerns the cold, we should notice that although swallows withstood it longer than expected, yet they showed less resistance than sedentary birds, such as Sparrows, Chaffinches, Green Woodpeckers, Goldfinches etc. Indeed, since I tested also these other species in the same manner used for Barn Swallows, I ascertained that they remained lively despite the many hours spent at -12°, -13° and even -15°. In addition, the duration of their survival in the icehouse was often equal to the one of individuals kept in cages at room temperature without food. This resilience to the cold is perhaps part of their constitution, since Nature destined them to live in our country in every season.

I will complete this Monograph with a general reflection inspired by the season in which I am writing.

Warm pleasant weather hardly ever remains in autumn. In mid-September, heavy rain fell on our countryside nourishing the ground, parched by a very long drought, followed by sunny and windless days. It was nice to feel the summer-like warmth which was still present. During several consecutive nights, the thermometer never went down below +10° and during the day it always ranged between +13° and +16° in the shade. These mild temperatures

have been extremely favourable to the plant and animal Kingdoms. Incredibly, plants have continued to vegetate and some of those which bloom in spring, were covered with flowers even in the autumn. In October, violets blossomed on the banks of canals and among the grassy meadows. The insects that at the first cold become torpid and hide underground were fully awake and very active. I could see swarms of them as I walked along the paths of gardens, meadows and groves.

Similarly to what I said about plants, several insects subject to metamorphosis had become adults and were flying, which normally happens late in the spring. After 20th October, some species of magnificently-coloured butterflies, which come out of their chrysalis in April-May, were enjoying the nectar of flowers. I was even more surprised in hearing the cicadas chirping, which were active for many hours every day in mid-October as they would be during the hottest days of July and August.

Certainly, if it is not the cold, it is the lack of food that drives migrating birds to leave our side of the world and move elsewhere where they can find enough food. Therefore, that year the Barn Swallows of Lombardy should have stayed longer. The fine weather persisting, the warm autumn temperature and the abundance of insects should have been a valid reason for them to stay longer. Yet, it did not happen. At the end of September nearly all the Swifts and House Martins had gone. Therefore, their departure was not delayed compared to the previous years. However, I noticed something else. Like elsewhere in Italy, also in Lombardy many other migrating birds come and go, such as Nightingales, Blackcaps, Wrynecks, Shrikes, Bee-eaters, Golden Orioles, European Nightjars (*M. luscinia*[54], *M. atricapilla*[55], *Yunx*[56], *Lanius*[57], *M. apiaster*[58], *O. galbula*[59], *C. europaeus*[60]), which are all insectivorous species. I was very careful in monitoring their departure and ascertained that despite this mild autumn they did not leave our areas later than in previous years.

All things considered, we must conclude that the birds' autumn migration is an ability or an instinct that is triggered at a prefixed time and drives them to move to a different climate zone, unconditioned by air temperature or decrease in food availability.

Indeed, this fact was also confirmed by observing the behaviour of another species at the time of migration. The great Buffon reported that Quails kept in captivity become restless, very agitated, slamming their wings against the

[54] *Luscinia megarhynchos* Brehm, 1831.
[55] *Sylvia atricapilla* Linnaeus, 1758.
[56] *Jynx torquilla* Linnaeus, 1758.
[57] *Lanius* sp.
[58] *Merops apiaster* Linnaeus, 1758.
[59] *Oriolus oriolus* Linnaeus, 1758.
[60] *Caprimulgus europaeus* Linnaeus, 1758.

bars of the cage trying to flee. This occurs in the months of September and April. A very diligent friend of mine from Reggio Emilia, who had the hobby of breeding the fledglings of Nightingales, told me that towards the end of September, when this species leaves our territory, the caged birds become very agitated, jump up and down, flutter their wings trying to get out at any cost; and this occurs especially during night hours. At first, when this friend of mine noticed this sudden behaviour during the night, he thought that it was caused by the presence of some disturbing animal, such as a cat, but immediately realised that there was nothing that should scare them. Indeed, after a few days the birds went back to their usual calm behaviour. That restless impulse to leave cannot be caused by the lack of food or by the cold since those who like to keep these birds feed them properly and protect them from the cold. Therefore, they develop a particular instinct that induces them to go away at pre-established periods of time.

Monograph no. 5 by Lazzaro Spallanzani

"The Great Swift[61] (*Hirundo melba*)"

The Alpine Swift *Tachymarptis melba,* syn. *Apus melba* (photo from Wikipedia).

Abstract

Very little is known of the origins of this bird, normally resident in the highest mountains, and on the steepest cliffs. The Author's comments on the different habits of this bird. Its proficient speed in flight. Its comparison with the Common Swift. About its arrival in our land. Nesting, hatching, and its offspring. The departure. Differences in breeding habits between the Common Swift and the Alpine Swift. This bird, if it falls to the ground, it can rise again and fly. Its description. The great length of the wings. Configuration and structure of the nest. The Alpine Swift exposed to the harsh cold. Nesting seasons of the Swallow, House Martin, Sand Martin and Alpine Swift, and notes on individuals wintering in adverse weather on the islands of Lipari. There seen flying on mild winter days. No likelihood that the intervals of rest are taken up in torpor. It has been suggested that the greatest number of these birds at the approach of winter go to Africa. Observations of the Author, which lead us to believe in this migration.

[61] The Great Swift (*Hirundo melba*), nowadays known as the Alpine Swift (*Tachymarptis melba,* syn. *Apus melba*).

Riassunto

Scarsissimo nota la biologia di questo uccello, perché in genere abita le montagne più alte e le rupi più scoscese. Osservazioni dell'Autore su diverse sue abitudini. La sua prodigiosa destrezza nel volo. Suo confronto con il Rondone comune. L'arrivo nelle nostre zone. Nidificazione, cova e pulli. La partenza. Differenze nel comportamento riproduttivo tra Rondone comune e Rondone maggiore. Anche quando cade a terra, si alza e riparte in volo. Prodigiosa apertura alare. Forma e struttura del nido. Il Rondone maggiore esposto alle inclemenze del freddo. Rondine, Balestruccio, Rondone, Topino e Rondone maggiore nidificanti, e casi di svernamento nelle Isole Eolie. Osservazioni a Lipari nelle tiepide giornate invernali. Nessuna evidenza che durante il riposo cadano in letargo. Massima probabilità che la gran parte di questi uccelli si sposti in Africa all'approssimarsi dell'inverno. Osservazioni dell'Autore, quali prove di questi spostamenti.

Although this species of Swallow was not unknown to the ancients, and is not rare in parts of Europe, being a typical inhabitant of the highest mountains and of the steepest cliffs, the ancient literature concerning it is far less than that for the other related species. This for me is a reason to try to increase the little that we do know of it, which is not much more than the bare description of this bird[62]. I found the Great Swift to be breeding in parts of Helvetia, the Palmaria Islands[63], Ischia[64] and Lipari[65], also in some ancient and eminent buildings of Pera[66] in Constantinople. However, there I was not allowed to acquire any knowledge above the general facts that the Great Swift appears to be black and white when in flight, compared with the all-dark appearance of the Common Swift, and is twice the size of the Common Swift, with the wings proportionately longer. I talked about the flight speed of the Common Swift. It can certainly reach very high speed, but the speed of these Great Swifts is certainly superior. Birds which fit such a description are also birds of prey, for instance kites. On the Apennines and Alps, but much more in my travel back to Italy from Constantinople to Vienna, crossing the immense mountain chain of Wallachia, Transylvania, the Banat and Lower Hungary, I saw a huge number of birds of prey, of every shape, size and of many kinds. I have sometimes come across them hunting when they hurl themselves onto other birds. I have seen these same birds when hunting in the East as trained falcons. Everyone knows this to be the moment of their fastest flights. I am not joking when I say that the flight of these Swifts, on the occasions when they achieve the highest speed, is even faster and even bolder. There is the greatest possible similarity in their daily lives between them and the Common Swift.

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[62] Cf. Philippe de Guéneau Montbeillard (1720-1785), who has written more than other authors have about the Great Swift (*le Martinet à ventre blanc*).

[63] Palmaria Islands: two small islands in the Ligurian Sea, Italy.

[64] Ischia: an island in the Gulf of Naples.

[65] Lipari: the largest of the Aeolian Islands (or Lipari Islands), north of Sicily.

[66] Pera: also known as Galata, now the core of Beyoğlu, a district of Istanbul, Turkey.

They fly in large and small flocks, in proportion to the sites they inhabit, swooping hundreds of times a day around the prominent rocks that protrude into the air from the cliffs that enclose their nests, accompanying these flights by an incessant clamour of noisy shrieking voices, this is what is common to these two species, with the difference, however, that the cries of these Swifts are stronger, sharper, and longer.

Another difference has been observed, and that is that these Great Swifts in the middle of their flights will often hang by their claws from the rough rocks near their nest sites, and that then others join them, eventually forming in this way a kind of animated pendant chain, which then melts away again, the birds all calling out as they leave; a curious habit which I never saw in the Common Swifts. This behaviour is one that I have witnessed many times while standing under those cliffs, under those rugged stony masses, in whose fissures the Great Swifts nest; but the inaccessibility of these places has prevented me from studying that other part of their natural history, that of most interest to the naturalist, that is, their breeding behaviour. Even now, I would be in the dark, if I had not known that in the mountains of Modena there was an ancient tower where every year the Great Swifts breed, and where every year the owners have the fledglings harvested, for their flesh is good to eat. This site is a high tower in Guiglia[67], close to the Palace of Casa Montecuccoli[68], and the small holes where the Great Swifts make their nests are as easy to visit and observe as the artificial nest places made elsewhere for the Common Swifts (see the third Monograph). This tower, an established nesting site which the Great Swifts use for breeding, can be accessed easily by man, and this is really something of a phenomenon in Italy. For although with the onset of summer storms I have seen more than one of these birds flying at great heights over the slopes of the Apennines, and I assume that they come from these mountains, this is not something that I can prove. However, at the cost of great effort I found that in Guiglia I could obtain the information that I had been searching for elsewhere in vain. This information, in response to my requests, was brought to me by a dear friend who was in contact with the custodian of the tower in Guiglia, who each year is responsible for harvesting the chicks and sending their breasts to the owner, the noble Lord Montecuccoli. The value of these results to me was immense, as it meant that not only did I now know things previously shrouded in mystery, but I could inform my Readers of them too.

The Great Swifts arrive in Guiglia usually around March 12th. Once they have arrived, they immediately lay their eggs in old nests; if the old nests are

[67] Guiglia is a village in the mountains of the Province of Modena (490 m a.s.l.).

[68] The Montecuccolis were a noble family of the Duchy of Modena. Raimondo Montecuccoli (1609-1680), a field-marshal of the Austro-Hungarian Empire, defended Austria against the Turks and eventually defeated them in the famous battle of the River Rába, Hungary, in 1664.

missing, they will build new ones. In order for the Great Swifts to build their nests more easily, the caretakers throw down small feathers from the tower windows, which are quickly taken by the Swifts in the air, then they are taken to their little nesting places and used for the construction of new nests. They have two broods; the first is of three or four eggs, and the chicks fledge in mid-July. The second is usually composed of only two eggs, and these chicks fledge about the second half of September. The incubation period is normally of three weeks. In hot weather, they also fly at night, and they can be heard screaming around the tower in mid-air.

They stay in the country until October, but at the first snowfall of the month or cold spell, they disappear. Although every year their fledglings are taken by the caretaker to be eaten, they return again the following year to breed. These peculiarities relating to their breeding when compared with those of the Common Swifts, reveals more and more essential differences between the two species. Firstly, the Great Swifts arrive considerably earlier than that of the Common Swifts. Next, the Great Swift has two broods while the Common Swift has only one. Finally, the Great Swifts do not abandon the breeding holes any earlier than October, while the Common Swifts fly away in July (see the third Monograph).

Although the report I have does not reveal if the Great Swift when resting on its nest, is affected by the same inertia that enables men to take it without it trying to escape, I think it must be, as I was sent a live Swift taken from a nest in Guiglia in July 1794, along with other specimens being stuffed and prepared for preservation in the Museum of the University of Pavia. The bird was fully mature, since when I tossed it in the air outdoors with a thin wire rope tied to its foot, it took off at an incredible speed. Placed on the bare ground, it flew away by itself, as does the Common Swift, yet it was necessary to tease it in order to get it off the ground, otherwise it did nothing but stir, spread its wings and slightly beating them against the soil, without lifting off. Just like mature Common Swifts, it was moderately fat and it weighed a little less than two mature Common Swifts I found. The upper side of the body and upper wings were dark-coloured, while the throat and belly were white, with a dark chest. I omit any further details, seeing as it is possible to read the detailed and beautiful description in the work of Montbeillard, which I have already referred to several times. Instead, I will pause for a moment to highlight the length of the wings, which are huge unlike any other small a bird, reaching 8 inches from the base to the wingtips, with a good 3 inches protruding beyond the tail. Such long and bow-shaped wings, as are those of these Swifts, clearly reveal their potential for high-speed flight, even for those who have never seen them alive and flying.

Having had a whole intact nest used by these swifts sent to me from Guiglia, I could now compare it with those of Common Swifts. Its concavity is

somewhat larger in all shapes and sizes and its structure show greater precision and meticulous work. Sticks, straw, poplar cotton and feathers, together with a pile of the bird's own excrement, form the bulk of the nest of Common Swifts. These different elements, being separate and not linked together by the nest maker, would not have been strong enough to form the consistency of a nest, if this same bird had not glued them together secreting gluten from its mouth (third booklet). None of this gluten can be seen in the nests of Great Swifts. The concavity is lined with a thin layer of delicate feathers interwoven. Under this layer can be seen straw and fescues[69], laid in concentric circles, closely intertwined, and strengthened by a huge number of minute leaves of woody plants, which are embedded in the spaces created by the interweaving of the circular straw layers. In this way, the nests acquire consistency and solidity. How then do these birds, who never rest on trees or on the ground, who eat, and even drink in the air and who have adopted flight as their natural state, collect the leaves from which they build a good part of their nests. We cannot understand it or explain it otherwise than by assuming that they catch these leaves whilst flying, once the force of the wind has blown them into the air.

When the young swift which was sent to me from Guiglia, came into my hands, it was already 31 hours since it had been taken from the nest, and after such long abstinence it must have been very weak. Even in this state, I wanted to expose it to those rigors of the cold, which other related species had experienced. For 7 hours it resisted inside a tube whose temperature was -8 ½ degrees. It died later in an ice room after having survived the cold for 25 hours. But in neither case did there occur any symptoms of lethargy. It remains, therefore, definitely proven that the various species of swallows which have thus far been discussed, which are the Barn Swallow, House Martin, Sand Martin, Common Swift and Great Swift never adopt such behaviour.

In the fourth tome of my *Viaggi alle Due Sicilie*..., I have already mentioned that these five species of swallows not only nest in the Aeolian Islands, but that some individuals from these species, except for the Sand Martin, winter there. That is why on clear winter days, somewhat warmed by the Scirocco winds, you may see them flying around, mostly along the streets of the city of Lipari. And when I left the islands in the middle of October, some Barn Swallows as well as Great and Common Swifts were roaming through the air. We can therefore conclude that it is true that during turbulent, less gentle, days (it is known that there are very mild winters on these islands) these swallows take cover in hidden places on the island where they find shelter. They do not, as I have said already, become lethargic during these times. I have demonstrated by my experiments that this passive state does not take place in these birds but

[69] Grasses of the genus *Festuca*.

rather that they fall into in a state of rest, let's say inertia, which they then come out of at the arrival of hot and sunny days, thanks to the insects awakened and freed by the mild temperatures, as well as showing more appetite than swallows when they are driven by hunger. There is no danger that in those times of abstinence the birds would perish, as they bring with them a kind of reserve adapted to feed them for a given time, which consists in that abundant fat with which they are coated, as I have seen in the Barn Swallow, in the House Martin caught at the end of September, when they were about to leave our lands.

With the exception of those individuals which spend the winter in the Aeolian Islands and in some parts of Sicily, as I have been informed of by farm workers, I think that most of their number migrate to Africa. And since it has been shown that swallows neither winter among us, unable to live because they lack the necessary food, nor do they go into hibernation, I do not see what other climate, outside Africa, would agree so well with such delicate little birds, when combined with the convenience of a quick and easy route from Europe to Africa. And I myself was in a way an eyewitness to this passage, because towards the end of October, due to having spent much time at the Strait of Messina to purchase phosphoric jellyfish (lc T. IV, Chap. XXVII), I observed at that time several flocks of the above-described swallows crossing over of the Strait, flying from North to South, that is to say in the direction of Africa.

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Common Swifts and House Martins flying around the clock tower of Fanano (artwork by Ariadne Trollenskog: @Trollenskog).